10th Biennial Noxious Weeds Conference

Practical Weed Management

Protecting Agriculture and the Environment

Ballina RSL Club
Ballina

20th - 22nd July 1999

NSW Agriculture

10th Biennial Noxious Weeds Conference

Conference Papers

Ballina RSL Club
Ballina
July 20 - 22, 1999

Rod Ensbey
Conference Convenor
NSW Agriculture
Grafton

Philip Blackmore
Papers Editor
NSW Agriculture
Armidale

Anne Simpson
Typing and Formatting
NSW Agriculture
Armidale

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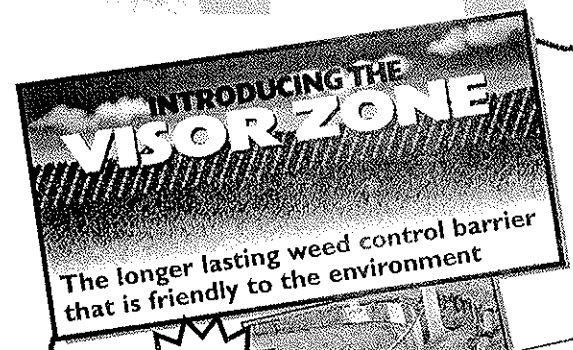

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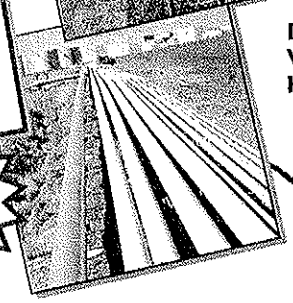

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Lantana	●	●	●	●	●	●		
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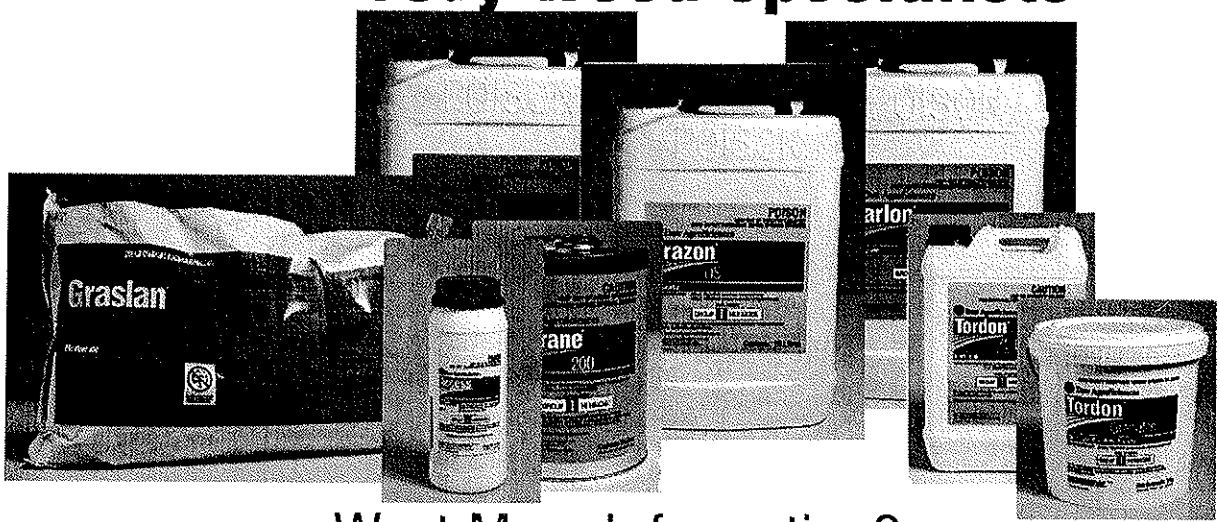

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Program

DAY 1

Time	Tuesday 20th July, 1999	

WELCOME AND KEYNOTE ADDRESS

Chairman: Dale Moore, Lake Macquarie Council

8.30	Welcome	• Malcolm Olive, Chairman FNCCC
8.45	Opening Address	• Alan Brown, Mayor Ballina Shire Council
9.00	Key Note Speaker Alligator and Aquatic Weed Control Challenges for the new Millennium	• Mic Julian, CSIRO Brisbane
9.50	Housekeeping	• Rod Ensbey, NSW Agriculture
10.00	**Morning Tea**	

NATIONAL AND STATE WEED STRATEGIES

Chairman: Paul Marynissen, Greater Taree City Council

10.30	A Strategic Approach to Weed Problems of National Significance	• John Thorp Project Manager, National Weeds Program
11.00	Weed Risk Assessment and Potential Weeds for NSW	• Paul Pheloung AQIS, Canberra
11.30	Review of the NSW Noxious Weeds Act	NSW Agriculture
12.00	Implementing State and Regional Weed Plans	• Richard Carter NSW Agriculture
12.30	**Lunch**	

CONCURRENT SESSIONS

	Session 1 - Auditorium Chairman: Eddie Lanting, Gosford Council	**Session 2 - Function Room Chairman: Barry Powells, Coffs Harbour City Council**
1.30	Siam Weed in Northern Qld, • Reece Luxton QLD DNR	Fireweed, A Community Divided • Ian Borrowdale, Shoalhaven Council
2.00	Cabomba & its Management • Tom Anderson Qld DNR	Willows & their Management • Bob Trounce, NSW Agriculture
2.30	Parthenium Status in Qld • Jim Willmott, Qld DNR Council	Gorse Management • Mark Williams, Blue Mountains Council
3.00	**Afternoon Tea**	

CONCURRENT SESSIONS

	Session3 - Auditorium Chairman: Robert Waller, FNCCC	**Session 4 - Function Room Kevin Waters, NETCC**
3.30	The Camphor Laurel Phenomenon • Bruce Scott, FNCCC	Serrated Tussock Management • Birgette Verbeek, NSW Agriculture
4.00	Aquatic Weed Management in USA • David Carlson, HRCC	Giant Sporobolus Management • David Officer, NSW Agriculture
4.30	Regional Weed Planning in the Riverina • Richard Graham	Chilean Needle Grass • Tony Cook, NSW Agriculture
5.00	**END DAY 1**	
7.30	Evening Meetings	- Elected Members Meeting - Committee Room 1 - Noxious Weed Officers Association - Function Room

DAY 2

Time — Wednesday 21st July, 1999

7.00-8.00	Breakfast provided	• RSL Club

CONCURRENT SESSION

	Extension Programs - Auditorium **Chairman: Frank McLeod, DLWC**	**New Regulations Function Room** **Chairperson: Kim Bellairs, FNCCC**
8.30	National Weedbuster Program • Salvo Viteli, Qld DNR	Nursery Industry and Weeds • Paul Recher
9.00	Mesquite Extension Program • Jo Cummins, DLWC	New Codes of Practice - Chemical Use • Ken Martin, WorkCover Authority
9.30	Working with Community • Terry Schmitzer, Hastings Council	Native Vegetation Legislation • Katrina O'Reilly, DLWC
10.00	**Morning Tea**	

CONCURRENT SESSIONS

	New Product Developments Auditorium **Chairman: Rod Griffith, Cessnock Council**	**Environmental Issues Function Room** **Chairperson: Lisa Russ, NPWS**
10.30	Dow Agrosciences	Environmental Weeds & Bush Regeneration • Rosemary Joseph
11.00	Macspred Weed Bug	Reviews of Environmental Factors for Weed Control, • Sonya Mellor, NPWS
11.30	Monsanto - Genetic Engineering	Integrated control Methods for GPG • Andrew Storrie, NSW Agriculture
12.00	Generex - Mico-herbicides Civicview - Weed recording program	Holistic Approach to Weed Control • Rebecca Lines-Kelly, NSW Agriculture
12.30	**Lunch**	
1.30	Field Trips - Agricultural Weeds - Environmental Weeds	FNCCC & NPWS
5.30	**Return**	

6.30 for 7.00 **Conference Dinner**

Dress - Semi Formal (Coat and Tie)

DAY 3

TIME	Thursday 22nd July, 1999	
8.00	Industry Equipment Demonstrations	RSL Car Park • Terry Schmitzer

LEGISLATION AND TRAINING
AUDITORIUM
Chairman: Peter Gorham NSW Agriculture

9.00	Herbicide Usage on and near Waters	• David Nicholson Environmental Protection Authority
9.30	Weed Officers Competencies and Future Weed Management Training	• Richard Carter NSW Agriculture
10.00	**Morning Tea**	

CONCURRENT SESSIONS

	LEGAL TRAINING AND ISSUES **Auditorium** **Chairman: Alan Bushby, UHWA**	**INTEGRATED WEED MANAGEMENT** **Function Room** **Chairman: Mike Dodkin, NPWS**
10.30	Interviews & the Evidence Act • Phil Blackmore, NSW Agriculture	Biocontrol of Environmental Weeds • Royce Holtkamp, NSW Agriculture
11.00	LCA Case Studies - Prosecutions	Biocontrol of Temperate Weeds, • Paul Sullivan, NSW Agriculture
11.30	LCA Case Studies - SEINS	Bitou Bush Integrated Control • Ken Hayes, Coffs Harbour City Council • Jeff Thomas, NPWS
12.00	Discussion and Question Time	Roadside Management and Weed Control • Tim Scanlon
12.30	**Lunch**	

REGIONAL CO-ORDINATION
AUDITORIUM
Chairman: Ian Turnbull, Bellingen Shire Council

1.30	Role of Regional Weed Advisory Committees	• Peter Gray, NPAO NSW Agriculture
2.15	Success of Regional Weed Action Projects	• Lower Hunter Project -Dale Moore • Sydney North Project - Jo Lynch • Sydney South Project - Luke McLachlan • State Mapping Project - Bruce Scott • Native Grasses Project - Jim Cherry
3.30	Conference Review	• Bryson Rees, President Weeds Officers Association, Wellington Shire.
4.00		

END

THE MANAGEMENT OF ALLIGATOR WEED, A CHALLENGE FOR THE NEW MILLENIUM

M H Julien, Research Scientist, and J N Stanley,
Post Doctorate Researcher
CSIRO Entomology,
Long Pocket Laboratories,
120 Meiers Road,
Indooroopilly 4068, Australia.

ABSTRACT

The recent spread of alligator weed in Australia is cause for considerable concern, earning it a place among the 20 Weeds of National Significance. Earlier predictions and recent infestations indicate that it will grow in most non-arid areas of Australia. However, it is usually associated with wetlands and water-ways. Current herbicides have limited use in controlling this weed. Physical removal may be useful for small, discrete and accessible patches but not for other infestations. Of the known biological control agents the most useful is limited to aquatic habitats and by climate. The current biological control knowledge, including the insects released in Australia, is based on several short-term surveys conducted in the native range of the weed in the 1960s. Those surveys suggest that many other insects are associated with alligator weed which might be suitable and safe for release. In particular a thrips, released in USA, should be assessed for release in Australia and a flea beetle that failed to establish following releases in Australia should be reintroduced. The recently identified wide spread of alligator weed as a backyard vegetable poses a serious dilemma for state authorities. Emphasis has been placed on education of the public and eradication particularly in those states were the weed was not previously known. This may eliminate small infestations and reduce the rate of spread but alligator weed will remain in Australia in significant and increasing amounts. It is essential that long-term management is developed and current knowledge suggests that a strategy should be developed with biological control as the major component.

INTRODUCTION

Alligator weed, *Alternanthera philoxeroides* (Mart.) Griseb., is native to South America, where its center of evolution is thought to be the Rio de la Plata Basin of southern Paraguay and northeastern Argentina, a wetland area of the Paraguay and Parana Rivers. It is also found in eastern and south-eastern Brazil, Bolivia, Uruguay and in Argentina south to Mar Del Plata (Vogt et al 1979). Other populations, thought to have resulted from spread have been found along the north coast of South America and in the Amazon region. This plant has become a serious weed problem in USA, China and Australia and has also spread to Puerto Rico, New Zealand, Burma, Thailand, Indonesia and India (Julien 1995).

Alligator weed has the ability to grow in both aquatic and terrestrial habitats of tropical, subtropical and temperate regions. It has gained status as a weed in introduced ranges because it grows rapidly to choke the habitats that it invades.

In aquatic habitats, it produces large mats of stem and leaf material which are generally anchored by roots to the bank and river bed and extend many metres across the water. These mats may exceed a

metre in thickness and may break loose to become free-floating. The weed disrupts the aquatic ecology by forming a blanket over the surface of water. It interferes with boat traffic, blocks drainage, displaces native plant species, adversely effects water quality, clogs intakes and effects flow and sedimentation rates.

In the terrestrial habitat it forms dense herbaceous stands with dense mats of stolons and root material underneath. Alligator weed is highly competitive with other plants and displaces pasture and other plant species (Julien and Bourne 1988). Cattle readily eat it but it has been linked with photo-sensitivity in calves and lambs (Roberts and Sutherland 1989). It has been declared noxious in all states of Australia.

Alligator weed propagates almost exclusively by vegetative growth. Viable seeds are not produced outside some areas of its native range. This limits the variability of the plant genome, which reduces its scope to evolve and may improve the prospects for biological control. New plants develop from a pair of shoots present at each node providing a large capacity to regenerate from cut or damaged stem material. Descriptions of the weed and its growth are given in Julien (1995), Julien et al (1992) and Sainty and Jacobs (1981).

ALLIGATOR WEED IN AUSTRALIA

It is thought that alligator weed entered Australia as a contaminant in ships ballast (Hockely 1974) because it was first found in swamps near the Carrington ship yards, Newcastle, in 1946. It was then recorded in the Williamtown/Fullerton Cove area (1962), East Maitland (1965) and later throughout much of the lower Hunter catchment. In 1967 it was planted at Woomargama near Albury as an ornamental. Alligator weed was found at Duck River and Haslam's Creek in the Parramatta River catchment in 1969 and in the Georges River and its tributaries in 1971. It was found at Camden in the Nepean River catchment (1981), a drain in Brisbane resulting from a glasshouse escape (1984) and in numerous locations between Sydney and Newcastle in the 1980s (Julien and Bourne 1988). Thereafter it spread in the Nepean River catchment, was found in the Botany Wetlands near Mascot, at Barren Box Swamp, Griffith (1994) and in Lake Ginninderra, Canberra, in 1995. It is likely that the later two infestations resulted from plant pieces inadvertently transferred when boats were moved from an infested area. Julien et al (1995) published a prediction of the areas in Australia suitable for growth of alligator weed that in general terms included all of the non arid regions, ie. the northern coast of NT, the entire east coast and slopes areas of QLD, NSW and Victoria except the high altitude regions of southern NSW and Victoria, the low altitude areas of Tasmania, the southern half of SA and the southern quarter of WA.

During December 1995 alligator weed was found growing in the vegetable garden of a neighbour by Dr Wendy Forno. Follow up work over the next four years by the state weed authorities has led to the discovery of cultivated plots of alligator growing throughout eastern Australia from Port Douglas to Tasmania, in South Australia, Western Australia and the Northern Territory. The weed was being grown as a leafy vegetable by some of the Sri Lankan community mistakenly believing it to be the popular vegetable Mukunu-wenna or
Sessile Joyweed (*Alternanthera sessilis*), a common vegetable in Sri Lanka (Gunasekera and Rajapakse 1998). The demand had reached such a level that it became available at vegetable markets in Brisbane and by mail-order purchase from the ACT. In Victoria over 700 backyard infestations and seven naturalised sites were located by early 1998 (Gunasekera and Rajapakse 1998). In Qld over 70 backyard infestations were located and a naturalised infestation was found in

the Logan River. In NSW infestations were found near Bangalow in the Byron and Wislon's Creeks as well as in areas of Woolongong, Dubbo, Parkes, Forbes Peak Hill, Brewarrina, Grafton, Lismore and Armidale. Five site were found in South Australia, three in Tasmania, 25 in WA and two in Darwin (J. Quinn pers. com. 1999).

Control of the weed has been limited by the lack of suitable herbicides, restrictions to the use of those few effective herbicides and the cost of their applications, the limited situations where physical controls are useful, and the restriction of the most useful biological control agent to aquatic infestations. Major concerns were raised following studies which showed large tracts of Australia, not yet infested, were suitable for infestation (Julien et al 1995). Concern escalated when it was also realised that this range extended far beyond the climatic limitations of the known biological control agents. The final straw came with the realisation that with the active spread as a vegetable plant, it is extremely likely that many catchments and agricultural systems will be invaded.

A few smaller and isolated infestations have been eradicated by manual removal, eg. Brisbane, or by the use of herbicides eg. Lake Ginninderra. Others are being treated with herbicides in an ongoing attempt to contain and control them. However, even as the weed was being widely spread as a vegetable and herb, it was also spreading naturally (plant pieces floating downstream) or being spread inadvertently (in produce or on machinery) to new locations.

CONTROL OF ALLIGATOR WEED IN AUSTRALIA

The methods that have been used to control the weed include the application of herbicides, physical removal and disposal, and the release of insects in biological control.

Herbicidal control

The weed is resistant to many chemicals and others kill tops but do not affect older stems, rhizomes or roots, especially if submerged. Recent research on a large number of chemicals and surfactants, alone and in combinations, identified three useful herbicides. Floating mats can be controlled with glyphosate, but it was of little use for terrestrial plants because only a small amount of the herbicide was translocated to older sections of the plant and the little that did was exuded through the roots (Bowmer et al 1993).

Terrestrial growth can be controlled using multiple applications of dichlobenil or metsulfuron. Dichlobenil is useful for spot treatments where bare patches are acceptable. It is effective on banks and in shallow water except where the substrate is loose, deep or organic. Metsulfuron provides selectivity for grasses and is useful over larger terrestrial areas but cannot be used where water may be contaminated (Sainty et al 1998).

Control using herbicides has been generally unsatisfactory due to lack of selectivity, concerns about water contamination, effects of unsuitable substrates, difficulty of access, cost of application and concerns over sections of disintegrating mats floating downstream and taking root (Sainty et al 1998). Many attempts to control alligator weed have been tried but few have provided eradication or containment (Julien and Bourne 1988). Chemical eradication of a relatively large infestation may prove possible when the Barren Box Swamp project is completed but the cost will be so great (around $2 million) that it is unlikely to be repeated many times. Case histories for herbicide control, in Sainty et al (1998), show the difficulties and limitation of this method. Chemical eradication of small infestations is currently being attempted in many backyards.

It has been suggested that until new compounds are available little progress will be made with herbicidal control and this is not expected in the near future.

Physical control (mechanical or manual removal)
The value of physical controls (mechanical or manual) is limited to small and isolated situations and is particularly useful in removing initial invaders of a catchment if they can be located early enough. A small number of attempts (nine) to physically control the weed have resulted in four instances of local eradication (Julien and Bourne 1988). Such techniques are only suitable when all plant material above and below ground can be removed (see Sainty et al 1998). Care must be exercised during removal since the dispersal of broken plant sections on equipment or downstream can greatly increase the spread.

Biological control
Eradication of the weed from catchments where it is well established is not possible, and despite all efforts to contain the weed it continues to spread. The aim of further work should be to limit growth by stressing the plant so that its competitive advantage and status as a weed are reduced. Biological control is the only method with the potential to provide such control over large areas and in inaccessible places, at an acceptable cost. Other methods can be integrated with biological control where it is sensible and affordable to do so.

Biological control was undertaken in the 1970s in Australia. Two insects were imported and released following their successful use in USA. A third insect was collected in South America and tested for the first time and subsequently released. The first two became established and lead to successful control of floating mats of the weed in central coastal NSW. The third, aimed at the terrestrial problem, failed to establish. Although successful in some areas biological control is limited because these insects established have particular habitat and climatic requirements. This is discussed further below.

This work largely depended on limited surveys for biological control agents that were conducted in South America in the 1960s by a US Department of Agriculture scientist. The information gathered then and since suggests that further research will identify additonal useful biological control agents. This is discussed below.

Recent concerns over management options for alligator weed culminated in a study, supported by the Hawkesbury-Nepean Catchment Management Trust with funds from NSW Agriculture. This study, undertaken by CSIRO Entomology, collected information about biological control of alligator weed and assessed the potential of further biological control initiatives. The unpublished report (Julien and Stanley 1998) included the following.

- A synthesis of the current knowledge about biological control collected from;
  - literature searches,
  - field visits to USA where control has been implemented and the native range of the weed in Argentina,
  - discussions with USDA scientists on alligator weed, and
  - archives of the late Dr George Vogt who undertook the early biological control surveys in South America.
- Proposals for further research that could provide Australia with additional safe biological control agents. These included;
  - the host testing in Australia of the thrips *Amynothrips andersoni,*

- a reintroduction of a flea beetle, *D. argentinensis,*
- the collection of various known natural enemies of alligator weed and studies of their biology and host ranges,
- surveys of the native range of the weed to extend the surveys undertaken in the 1960s to include the whole of the range of the weed and across the seasons, and to search for potentially useful pathogens, and
- studies of the biology and host ranges of new, potential agent found during the surveys.

A precise of the report follows.

HISTORY OF BIOLOGICAL CONTROL OF ALLIGATOR WEED

USA

Alligator weed has spread to become a major aquatic weed in the southern and southeastern states of USA. In the late 1950s a project was developed and surveys in South America for natural enemies of the weed began in 1960 and continued for a number of years. Details of the surveys are set out in unpublished reports by USDA researcher involved, Dr George Vogt, and in Vogt (1973).

Vogt listed the insects that he thought were the main suppressants of alligator weed as well as those he considered to be of less importance. Research concentrated on the main suppressants; the flea beetle *Agasicles hygrophila* (previously referred to as *Agasicles conflueta, Agasicles connexa* and *Agasicles* n. sp.), the moth *Arcola (Vogtia) malloi* and the thrips *A. andersoni.*

These insects were host tested in Argentina or USA, found to be host specific and were released in USA in 1964, 1971 and 1967, respectively. Considerable effort was put into releasing and spreading the flea beetle and the moth, resulting in the destruction of many of the large floating mats of aquatic alligator weed in the warm regions. They were less effective in the hot areas of southern Florida and in the northern range of the weed where cold prevented survival by the insects in the winter (Coulson 1977). An attempt to introduce a cold tolerant strain of the flea beetle from the southern range of the weed in Argentina did not improve control in the cooler areas (Buckingham et al 1983). Neither of these insects have a significant impact on the weed in terrestrial habitats. However, in USA less importance is attached to the weed when it grows terrestrially compared to Australia or China.

It is unclear why less effort was put into the rearing and releasing of the thrips in USA. Apparently the insect does not naturally disperse widely, and despite this it was not widely distributed by the USDA. There has been no evaluation of its impact. However, at least in one instance it decimated the weed growing on banks of a channel in Florida to the extent that evaluation of the impact of other agents could not be continued (W. Durden pers. comm. 1998).

Considerable resources (herbicide applications) continue to be applied to control alligator weed in channels and impoundments in USA, particularly in cooler areas where the agents do not provide control.

The only other related work was being conducted at the Federal University of Viçosa, Viçosa, Brazil, where the fungus *Nipia alternaria* (previously *Alternanthera alternaria*) was isolated and its impact and host range was studied. Recently work has been conducted at the University of Florida, Gainseville, where a virulent strain from Florida was isolated and its host range studied. Mass

culturing techniques have been developed and dew point studies are underway. Preliminary field trials resulted in very significant damage after one application to bank growth. The outcome of this work could be a mycoherbicide.

AUSTRALIA

Biological control began in Australia with the importation, host testing and release of the flea beetle *A. hygrophila* and the moth *A. malloi* in 1977. Both became established and within a few years the floating mats of the weed on the Georges River and it tributaries, near Liverpool, were reduced to edge infestations. Each year the weed regrew in spring and summer to develop mats over the water but before they could cover more than a metre or so they were again reduced by an increase in the control agents. The main controlling agent in Australia appeared to be the flea beetle, whereas in USA, considerable impact on the weed was attributed to the moth. This highlights the differences that can occur in different locations.

The life cycle of the flea beetle is orientated towards the aquatic habitat and it is unable to develop populations in terrestrial habitats. The moth also appears to have similar restrictions although damaging populations occurred on banks in Sydney and low populations persisted in paddocks invaded by the weed near Williamtown.

During survey work in the late 1970s on other aquatic weeds in South America, another flea beetle, *Disonycha argentinensis* Jacoby (Coleoptera: Chrysomelidae) was collected and sent to Australia for study. The life cycle of this insect was orientated towards terrestrial growth. It was found to be host specific and was released in 1980 and 1981 but failed to become established. The reasons for its failure were not clear although humidity requirements were considered (Julien and Chan 1992).

OTHER COUNTRIES

A. hygrophila has been released in New Zealand where it destroys tops annually but the weed regrew in spring. Control was limited by cool winters (Stewart et al 1996). It was also released in China where it provided good control in warmer areas but was limited by cold in the northern range of the weed. Inoculative releases provide control in some areas where the insect could not over winter. In Thailand the insect has provided substantial but seasonal control. *A. malloi* was released in New Zealand in 1984 when it failed to become established, and again in 1987 when it became established but has not provided control. *D. argentinensis* was released in New Zealand in 1982 but failed to become established (Julien and Griffiths 1998).

MAJOR POINTS FROM PREVIOUS RESEARCH

The major points arising from previous research.

- The flea beetle *A. hygrophila* has been highly successful at controlling the weed in the aquatic habitat Control occurs were winters are mild, sometimes within several seasons after release. Such results were observed in USA, Australia and Thailand. In cooler areas this insect might survive but lower temperatures limit population increase and it cannot control the weed. In locations where frost or ice eliminate tops populations of the insect cannot survive. Populations may recolonise annually from warmer climes but fail to increase to damaging levels prior to the next winter (Coulson 1977).

On the other hand, alligator weed withstands frost and ice. Exposed top growth is killed while the undergrowth of stems and roots survive to sprout in spring.

- The moth *A. malloi* has also been successful, sometimes reaching controlling populations within one year but generally is slower to build up numbers than *A. hygrophila*. It has a greater impact on terrestrial populations of the weed than the beetle. Although this may have been significant in USA it has not provided control in terrestrial situations in Australia.

- The impact of the thrips *A. andersoni*, released only in USA, has not been evaluated but has not been considered particularly effective. Predation by *Orius* spp., minute pirate bugs, has been suggested as a reason. However, the thrips damages growing tips of stems that may have insidious effects that stunt growth and reduce vigour, contributions that might go unnoticed in the presence of the other two agents. The thrips builds populations on bank growth and when levels are high may move onto alligator weed growing over water.

- Surveys conducted in South America in the 1960s (Vogt 1973) identified a number of organisms associated with alligator. Table 1 lists the insects that have been studied and released as biological control agents. Table 2 lists those insects that appear to have an affinity with and may be specific to alligator weed and therefore warrant further assessment. Table 3 lists the other organisms most of which lack identification or which are thought to have affinities with other plant species but also warrant further consideration. The information for the last two tables was mostly compiled from Vogt (1973), Vogt et al (1979).

  With the exception of *Agasicles* species, *Disonycha* species, *A. andersoni* and *A. malloi*, little is known of the other organisms observed by Vogt. He made observations during two field trips in successive years, and serious flooding limited work during one of those trips. He made several other visits in later years but mostly to alligator weed in other areas of South America rather than the considered epicenter of evolution. Furthermore, many of the organisms Vogt listed were the result of one or a few observation, often of immature stages that could not be reared to adult. Vogt's work was significant in that he selected the important insect *A. hygrophila* for further work. However, the most obvious and abundant insects are not necessarily the best biological control agents. His observations on the bulk of the natural enemies of alligator weed are, at best, very preliminary. Few of the insect species he indicated were associated with alligator weed were identified.

PROPOSED BIOLOGICAL CONTROL RESEARCH FOR AUSTRALIA

Import and test the thrips *Amynothrips andersoni*

The thrips should be collected from its native range and imported into quarantine in Australia for host specificity testing. Field observations and host range tests conducted in USA suggest that it is restricted to two species, alligator weed and *Alternanthera hassleriana* (a native of South America that does not occur in Australia). Within a year this insect could be checked and released. It is orientated towards terrestrial alligator weed although it will also attack the weed growing over water. Being more cold tolerant than the two control agents already established in Australia, the range of control could be increased. Although it appears not to have contributed to control in USA there are many examples of agents being useful in one country and not in others, for instance the alligator weed moth *A. malloi* has been attributed with significant effects in USA but not in Australia.

***Import and test the flea beetle* Disonycha argentinensis**
This insect should be reconsidered. *D. argentinensis* was released in Australia in 1980 and 1981 but failed to become established. Specific humidity requirements were thought to have been involved. However, many issues can effect the initial establishment of a population while population size is low, eg. weather, genetic composition, predation, micro-climate and micro-habitat.

This insect is terrestrially orientated; it pupates in the soil. For this reason it is suggested that a second importation, and release be attempted. Newly imported material would have to be checked in quarantine against a selected number of plants to confirm its host specificity. The previous host specificity testing on this insect was carried out in Australia in 1979 (Sands et al 1982) when less emphasis was placed on native species. There is likely to be a requirement to test additional plants particularly the native *Alternanthera* species.

This raises the issue that the promotion of *A. sessilis* as a vegetable plant may limit biological control. It is desirable to encourage people not to grow alligator weed and offering an alternative plant may assist this. However, it seems short sighted to encourage the use of another plant that could jeopardise biological control. Many biological control agents utilise a small group of related plants. If *A. sessilis* was included as a host for a potential agent for alligator weed reviewers of a release application may reject that agent. Alternatively, support by the state reviewers may be required to gain the release permits on the basis of the greater benefit of controlling alligator weed.

Survey for, study and test new insects and pathogens that attack alligator weed in its native range
Vogt's surveys found up to 60 species of insects attacking alligator weed in South America. Details such as their host plants, their association with alligator weed, mode of damage, are not known about most of these, see Tables 2 and 3. In addition, Vogt et al (1979) calculated that 39% of the native range of alligator weed remained to be surveyed.

Surveys conducted regularly over a range of seasons for a number of years would add considerably to the number and knowledge of species associated with the weed. This will then allow a selection of those natural enemies of the weed that should be studied further as potential control agents. Surveys and studies would provide the information to accept or reject the organism listed in Tables 2 and 3 for further study. Potential agents would be prioritised for studies in quarantine in Australia to determine suitability for release.

In Australia, survey for virulent strains of the fungus* Nipia alternaria, *for possible development as a mycoherbicide.
A virulent strain of this fungus has been identified in Florida and preliminary tests using one application to terrestrial growth killed above ground growth. Simple mass culturing and storing techniques have been developed. This fungus is not host specific and could not be introduced to Australia. However, it is possible that it already exists here (this should be confirmed) in which case material could be collected and studied.

There is not likely to be a commercial market for such a product. However, research and development of a useful mycoherbicide may have a positive benefit to cost ratio compared to the currently used herbicides. Such a mycoherbicide may provide better selectivity than existing herbicides.

CONCLUSIONS (Take home messages)

- The rate of spread of alligator weed over the last decade has increased dramatically.
- Alligator weed threatens to seriously disrupt agricultural systems and conservation areas particularly in irrigation, floodplain, riverine and wetland systems.
- The current controls of this weed are insufficient to significantly contain and reduce the Australia wide problem.
- It is unlikely that there will be an improvement in control using herbicides until new compounds become available.
- Management strategies should aim to limit spread by eliminating small isolated infestations and by raising the awareness about the weed.
- Biological control appears to be the only method that has the potential to improve control.
- Understanding that the lead-in time to search for, identify, test and release a new control agent is likely to exceed five years, surveys for new agents should beginning immediately.
- The thrips should be imported into quarantine in Australia and studied as soon as possible. This should take about a year.
- The flea beetle *D. argentinensis* should be reintroduced, additional plants tested if required, and released as soon as possible. This should take less than a year.
- Careful consideration should be given before further promotion of other *Alternanthera* species as vegetables as this might jeopardise the acceptance for release of some potential biological control agents.

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TABLE 1 Insect natural enemies of alligator weed currently used as biological control agents.

Order; Family	Genus and Species	Comments
Coleoptera; Chrysomelidae	*Agasicles hygrophila*	Successful agent in USA, Australia, China Thailand and New Zealand.
Lepidoptera; Pyralidae	*Arcola malloi*	Successful agent in USA and Australia
Thysanoptera; Phlaeothripsidae	*Amynothrips andersoni*	Introduced and established in USA
Coleoptera; Chrysomelidae	*Disonycha argentinensis*	Introduced to Australia and New Zealand, not established

TABLE 2 Insect natural enemies of alligator weed that are primary candidates for further study.

Order; Family	Genus and Species	Comments[1]
Coleoptera; Chrysomelidae	*Agasicles connexa*	Thought to be restricted to amphibious amaranths but not tested
Coleoptera; Chrysomelidae	*Agasicles opaca*	Thought to be restricted to amphibious amaranths but not tested
Coleoptera; Chrysomelidae	*Agasicles vittata*	Thought to be restricted to amphibious amaranths but not tested
Coleoptera; Chrysomelidae	*Agasicles interrogationis*	Thought to be restricted to amphibious amaranths but not tested
Diptera; Agromyzidae	*Melanagromyza alternanthera*	No observations
Diptera; Agromyzidae	*Melanagromyza marellii*	No observations
Diptera; Agromyzidae	*Ophiomya buscki*	No observations
Coleoptera; Chrysomelidae	*Disonycha eximia*	Thought to be restricted to amphibious amaranths but not tested
Coleoptera; Chrysomelidae	*Disonycha camposi*	Thought to be restricted to *Amaranthus* and *Alternanthera*.

[1] Amphibious amaranths include five species; *Alternanthera philoxeroides, A. hassleriana, A. sessilis, A. reineckii* and *A. tetramera.*

TABLE 3 Organisms referred to in Vogt (1973), Vogt et al (1979 and Vogts unpublished reports. Some may correspond to species that were identified in later work and are listed in other parts of this table. Many have not been identified and little to nothing is known about them. Many may not be primarily associated with alligator weed.

Order; Family	Genus and Species	Comments
Coleoptera; Chrysomelidae	*Disonycha conjuncta*	Thought to occur on *Iresine diffusa*
Coleoptera	*Diabrotica* sp. 2	
Coleoptera; Chrysomelidae	*Systena* sp. 3	
Coleoptera; Chrysomelidae	*Phenrica*	
Coleoptera; Curculionidae	2 species	
Lepidoptera; Arctiidae	2 to 3 species	
Lepidoptera; Noctuidae	1 specie	
Lepidoptera; Pyraustidae	1 specie	
Lepidoptera; Phycitidae	2 species	One was probably *Arcola malloi* see Table 1
Lepidoptera; Pyralidae	2 species	
Lepidoptera; Tortricoidea	1 specie	
Lepidoptera; Hesperidae	1 specie	
Lepidoptera; Lycaenidae	1 specie	
Diptera; Cecidomyiidae	2 species	
Diptera; Agromyza	3 to 5 species	
Diptera	1 specie	
Diptera; Pergomyia	1 specie	
Thysanoptera;	1 or 2 species	Probably *Amynothrips andersoni* - see Table 1. Reference to two species may refer to the long and short winged variants of *A. andersoni.*
Hemiptera; Cicadellidae	3 to 5 species	
Hemiptera; Fulgoridae	1 or 2 species	
Aphididae	1 or 2 species	
Acarina		
Diptera; Chironomidae		

NATIONAL WEEDS STRATEGY

"A Strategic approach to weed problems of National significance"

John R Thorp
Project Manager
National Weeds Strategy, Launceston

INTRODUCTION

Quite often strategies developed at the National level are not seen as helping on the ground at landholder and manager level. On occasions local governments have not been involved, although they are sometimes a key service provider. Whilst the National Weeds Strategy (NWS) is a whole of government activity it will have failed if management of weeds on the ground is not enhanced and improved.

The NWS is not narrowly focused on short-term spray, slash and burn programs, but a well thought out, weed management strategy, requiring skilled people providing integrated programs well into the new millennium.

It is expected that every aspect of weed management will be reviewed, evaluated and improved, as improved training increases the number of skilled staff within local government, public service, community groups and the conservation sector.

Of course many other effects will be seen, but none will have such far-reaching consequences as the improved training of weed management staff, resulting in a higher profile, recognition for a skilled job and increased professionalism.

NATIONAL WEEDS STRATEGY – WHO?

Two Ministerial Councils and Forestry Ministers established the strategy with the agreement of the Commonwealth, and all States and Territories.

An Executive Committee was formed to implement the strategy and a project manager appointed to support the activity.

The diagram 1 shows how the National Weeds Network is structured and its relationship to the governments of Australia.

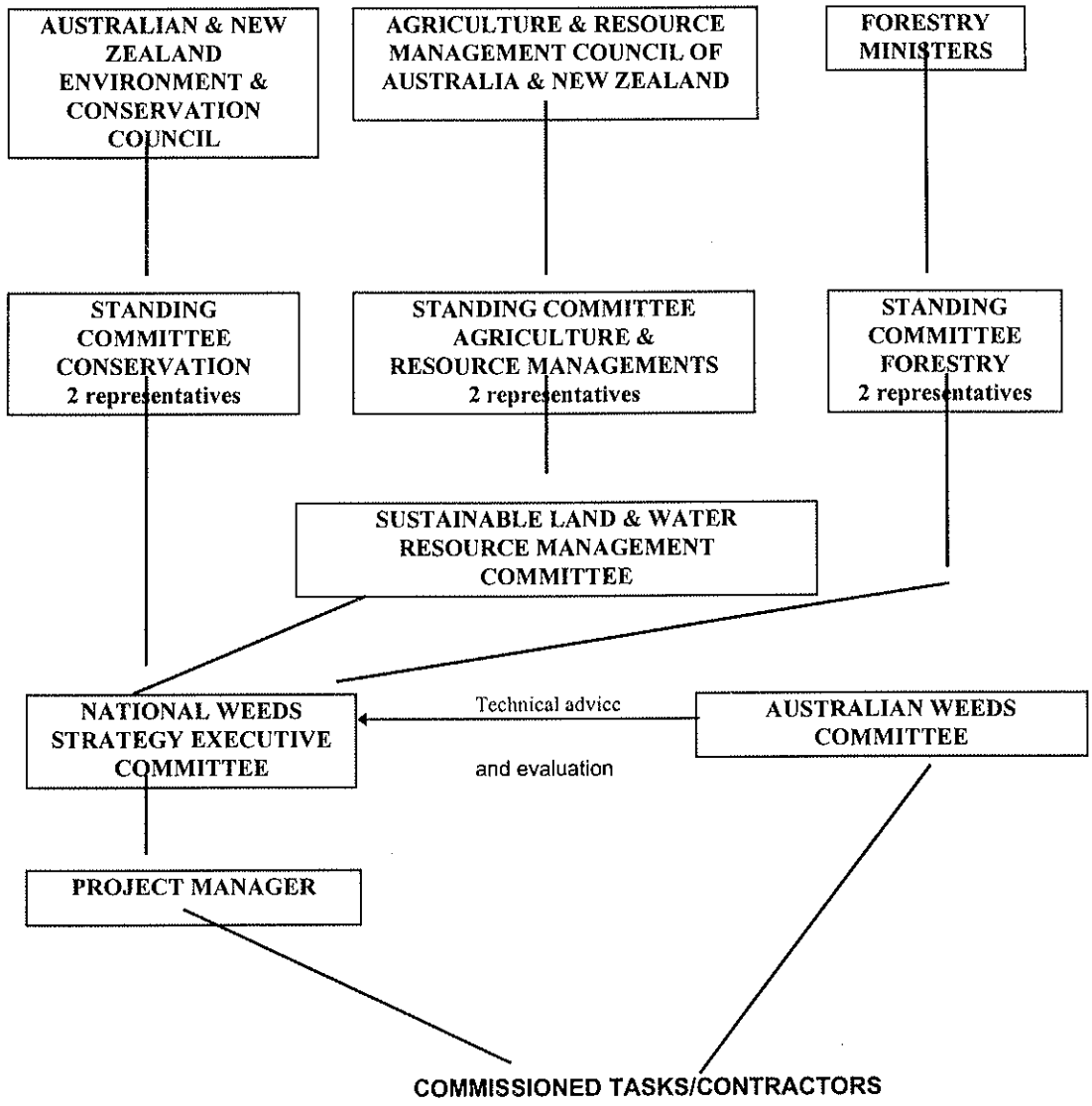
WORK DONE TO DATE

Quarantine

The quarantine barrier has been strengthened with the inclusion of a test for weediness for imported plants. The use of prohibited and permitted lists, combined with weed risk assessment has been in operation since 1998, making it unlikely that new weed problems will legally be imported into Australia in the future.

We now have an ever-increasing network of people committed to weed management, with co-operation across the nation.

Figure 1
NATIONAL WEEDS STRATEGY EXECUTIVE COMMITTEE REPORTING ARRANGEMENTS



Weedbuster (started in Queensland) is now national and growing, with wide recognition as a once a year weed awareness activity aimed at the community.

The seed and nursery industries are aware of the problems that they can cause by unintentionally distributing weeds and are working towards minimising these problems.

A process for determining weeds of national significance has been established, species assessed and at the time of writing the first list was nearing announcement.

The development of national training competencies is in its final draft almost complete.

WORK TO DO IN 1999/2000

Implement strategy development and action on Weeds of National Significance.

Finalise national training competencies for weed management. The start of developing a more professional national workforce with job mobility and recognition of prior learning.

Increase national publicity on weed issues in both publications and through all sectors of the media. This includes preparation of high quality weed identification cards that can be assembled into regional decks for local government, state government departments, industry, community groups and any body requiring a weed identification product. Production is scheduled for testing by mid 1999.

Detection of weed incursions is a key part of preventing the establishment of new weeds. Development of a national spotting and identification system is a high priority.

All States and Territories are being encouraged to develop contingency plans for handling new incursions in order to ensure that outbreaks are efficiently and effectively dealt with, sooner rather than later.

Genetic resource centers, botanic gardens and arboreta all hold potentially weedy plants or seeds, which could be released in the wider environment. It is proposed to develop protocols for holding and release of the material, with the need for high-risk species being destroyed.

Herbaria are being encouraged to report new naturalisations to the Committee, so that they may be assessed for weediness and eradication or other controls put in place before the weed becomes a widespread problem.

A number of today's weed problems were yesterdays newly bred agricultural plants. Codes of practice are to be developed and introduced, which require that new lines are tested for weediness prior to release and that weedy material does not escape form field trials.

Legislation and the underlying principles vary between jurisdictions. Restrictions on importation, sale and planting into states, territories and local government areas is extremely varied, with some being pointless or targeting inappropriate species. Consequently it is proposed to develop a set of underlying principles which jurisdictions adopt to improve the effectiveness of legislative tools. For a list of Noxious weeds for Australia, visit **WWW.WEEDS.ORG.AU**.

Legislative tools must be appropriate and used effectively, otherwise have them repealed.

In the past weed management has often been short sighted, overly reliant on spray, slash and burn or overlooked key dispersal mechanisms. As a result many programs have been less effective than they might have been. To solve this problem, all jurisdictions are being encouraged to be more strategic in their approach. States and territories are developing weed strategies. Species and land based strategies are becoming more widely used with key stakeholders being involved in their planning and development.

In recent times the nursery industry has been shown to be a source of weedy material and the industry is discussing mechanisms for reducing this risk. Aquatic plant producers also pose a threat, a problem being addressed in Queensland, as they are a major supplier of aquarium plants. However the nursery industry is well aware of the problem and is working on the issue with the CRC for Weed Management Systems and the National Weeds Strategy.

TAKE HOME MESSAGE

In implementing the National Weeds Strategy, numerous ongoing measures are being put in place that will reduce Australia's exposure to weed problem and encourage on the ground works. But to be successful it requires a national team effort across the community.

So what will you do!

The national Weeds Strategy is available at no charge for distribution from:

Community Information Unit
Environment Australia
GPO Box 787
CANBERRA ACT 2601
Tel: 1800 803 772
Email: ciu@ea.gov.au

National Weeds Strategy contact details:

John R Thorp
Project Manager
16 Flower Court
LAUNCESTON TAS 7250
Phone: 03 6344 9657
Fax: 03 6343 1877
Mobile: 0419 323 400
Email: jthorp@jta.com.au
Web: www.weeds.org.au

PREVENTING THE INTRODUCTION OF POTENTIAL NEW WEEDS TO AUSTRALIA

Paul Pheloung
Manager, Weed and Forest Team
Australian Quarantine Inspection Service
GPO Box 858, Canberra, ACT 2601

INTRODUCTION

New species and varieties of plants have been brought into Australia continuously since European colonisation. While a proportion of these are beneficial and contribute to the quality of Australian life, a similar proportion have naturalised and become weeds of production or the natural environment. The demand to import new plants continues; in a global environment of free trade and easier access to novel plants, this demand is likely to continue to grow.

Eradication of weeds can be very expensive and is unlikely to succeed unless the infestation is detected at a very early stage. Containment and control are also costly and the cost persists indefinitely. The costs involved in identifying potential new weeds and denying their entry to Australia are very small by comparison.

The National Weeds Strategy (NWS; ARMCANZ, 1997), which was formally implemented in 1997, identified the development/ and introduction[2] of measures to exclude new weed introductions as a primary goal. A review of Australian quarantine (Nairn *et al.* 1996) made similar recommendations. In recognition of this, and with funding support from the NWS, the Australian Quarantine and Inspection Service (AQIS) has implemented a process to screen plant introductions for potential weeds.

TRADE VS RISK

Quarantine risk can only be eliminated by eliminating all trade, tourism and other movements across Australia's international borders. As Australia is largely dependent on trade and tourism for the quality of life Australians enjoy, AQIS imposes conditions on imported commodities to manage the quarantine risk and achieve an appropriate level of protection for animal, plant and human health and the environment. Appropriate level of protection refers to the need for consistency, benefits over costs associated with a trade activity and the diminishing returns of additional measures to further reduce risk.

As a member of the World Trade Organisation (WTO), Australia is committed to an open international trading environment. AQIS applies a conservative approach to the management of quarantine risks, but must justify the conditions and restrictions the Commonwealth imposes on the grounds of sound quarantine risk or be accused of erecting economic barriers to the detriment of traders seeking to buy or provide a cheaper or novel product.

Determining the quarantine risk of new plants requires scientific knowledge that may not be available. The precautionary principle in essence states that, in the absence of scientific information necessary to assess risk, the risk should be avoided, that is, the import should not be allowed.

The Sanitary and Phytosanitary (SPS) agreement between WTO members (WTO, 1994) allows for restrictions on trade where such trade can lead to adverse affects on plant health. The agreement requires a sound and clear technical basis for such restrictions. While the precautionary principle requires scientific data to justify trade, the SPS agreement requires such data to justify restrictions

on trade. AQIS must find an appropriate balance to achieving these principles and has implemented the Weed Risk Assessment system to do this.

THE POLICY

AQIS has adopted a three tiered *permitted list* approach to managing the risk of proposed new plant introductions becoming weeds in Australia. Details of the system have been described elsewhere (Pheloung 1995, 1996, Steinke and Walton 1999) but are outlined here.

The permitted list

In June 1998, the Proclamations to the 1908 Quarantine Act were revised into one document that includes Schedule 5, the list of Permitted Seeds. Seed of plants included on this list may be imported subject to inspection to ensure freedom from soil, insects, contaminant seeds or other material of quarantine concern (other propagating material may have conditions to address the risk of associated pest and disease). This list currently contains 5700 plant taxa, over 2600 of which are plant genera. The list is intended to contain plants native or established in Australia and is currently under detailed review to verify the contents and, ultimately, replace all genera with species.

All plant species not on the permitted list are prohibited entry into Australia, except where AQIS issues a permit to import. AQIS does not issue permits to import for assessed weeds or for unassessed taxa. However, permits are issued for many crop species that require growth in quarantine. This includes species that are not necessarily weeds but potential carriers of disease. For example, *Triticum* (wheat) and *Eucalyptus* are not on the permitted list because they have the potential to introduce seed-borne diseases and consequently imports require treatment and growth in quarantine.

The permitted list is added to as proposed new plant introductions are assessed to be a low weed risk.

The Weed Risk Assessment (WRA) system

The WRA system is a scoring system used to determine weed potential based on existing knowledge of proposed new plant introductions (Figure 1). The questions relate to knowledge of the status of the plant as a weed outside of Australia, climatic preferences, undesirable attributes, growth, reproductive and dispersal attributes. The system includes consideration of attributes that make a plant less weedy. Not all questions need to be answered in order to generate a result.

The system was designed so that the score produced would be a measure of its weed potential. A calibration process using a complete spectrum of 370 weeds, non-weeds and useful plants already present in Australia, was used to convert the score to one of three outcomes, reject, accept or further evaluate. The WRA is reasonably reliable in rejecting weeds while accepting non-weeds, but to minimise the proportion of incorrect outcomes (rejecting non-weeds or accepting weeds), about 30% fell within the further evaluate category. From a quarantine standpoint, plants falling into this category are not permitted entry, in accordance with the precautionary approach, unless a more detailed examination of the biology satisfactorily resolves the concern.

AQIS adopted the WRA formally in 1997 as part of the three tiered process to assess new plant introductions.

The three tiered process

AQIS's three tiered system to screen proposed new plant introductions for weed potential is illustrated in the Figure 2.

Tier 1 A client wishing to import a plant advises AQIS. AQIS determines if the plant is listed on the schedule of permitted seeds or has previously been assessed. The taxonomy is also checked to determine if the name given is correct or is a synonym of a previously dealt with species.

Tier 2 WRA is undertaken on taxa that are not on the permitted list and have not previously been examined by AQIS. Accepted species are added to the permitted list and AQIS keeps a record of species rejected by WRA to prevent repeated effort. The client is advised of species requiring further evaluation and in some cases may be able to supply additional information that leads to a definitive WRA outcome. Up to this point, AQIS bears the cost of assessment.

Tier 3 Species requiring further evaluation must be assessed in greater detail, at the client's expense. An assessment protocol involving further experimentation either offshore or onshore under quarantine supervision and possible cost benefit analysis is being developed in consultation with stakeholders.

Performance

In the two years of operation of the three tiered system, AQIS has undertaken WRAs on 434 applications to import new plants – this just represents those applications that progressed to the second tier. Table 2 shows the outcomes. The majority of species (62%) were accepted and the WRA was unable to reject or accept 11%, which is a marked improvement on the 30% that fell into the further evaluate category during calibration of the system.

Table 2 lists the species that were rejected (19% of the total). Critical factors leading to rejecting a taxon varied from evidence of weedy behaviour in other parts of the world to biological attributes of reproductive capacity and dispersal mechanisms. Because of the uncertainty of prediction, many (possibly all) of these taxa may not, given the opportunity, become significant weeds in Australia. Nevertheless, there is a significant risk that at least some would become important weeds and the combined cost of assessment is negligible in comparison to the costs associated with just one such introduction.

		Botanical name:		*Kochia Scoparia*	Outcome: Accept <0 Evaluate 0-6 Reject >6	Reject
		Common name:		Kochia	Score: (Ag = 10; Env = 9)	11
		Family name		Chenopodiaceae	Your name:	PCP
				History/Biogeography		
A	1	*Domestication/*	1.01	Is the species highly domesticated? If answer is 'no' got to question 2.01		N
C		*cultivation*	1.02	Has the species become naturalised where grown		
C			1.03	Does the species have weedy races		
	2	*Climate and*	2.01	Species suited to Australian climates (0-low; 1-intermediate; 2-high)		2
		Distribution	2.02	Quality of climate match data (0-low; 1-intermediate; 2-high)		2
C			2.03	Broad climate suitability (environmental versatility)		Y
C			2.04	Native or naturalised in regions with extended dry periods		Y
			2.05	Does the species have a history of repeated introductions outside its natural range		Y
C	3	*Weed*	3.01	Naturalised beyond native range		Y
E		*elsewhere*	3.02	Garden/amenity/disturbance weed		
A			3.03	Weed of agriculture/horticulture/forestry		Y
E			3.04	Environmental weed		
			3.05	Congeneric weed		
				Biology/Ecology		
A	4	*Undesirable*	4.01	Produces spines, thorns or burrs		N
C		*traits*	4.02	Allelopathic		Y
C			4.03	Parasitic		N
A			4.04	Unpalatable to grazing animals		N
C			4.05	Toxic to animals		Y
C			4.06	Host for recognised pests and pathogens		
C			4.07	Causes allergies or is otherwise toxic to humans		
E			4.08	Creates a fire hazard in natural ecosystems		Y
E			4.09	Is a shade tolerant plant at some stage of its life cycle		N
E			4.10	Grows on infertile soils		
E			4.11	Climbing or smothering growth habit		N
E			4.12	Forms dense thickets		N
E	5	*Plant type*	5.01	Aquatic		N
C			5.02	Grass		N
E			5.03	Nitrogen fixing woody plant		N
C			5.04	Geophyte		N
C	6	*Reproduction*	6.01	Evidence of substantial reproductive failure in native habitat		
C			6.02	Produces viable seed		Y
C			6.03	Hybridises naturally		Y
C			6.04	Self-fertilisation		Y
C			6.05	Requires specialist pollinators		N
C			6.06	Reproduction by vegetative propagation		N
C			6.07	Minimum generative time (years)		1
A	7	*Dispersal*	7.01	Propagules likely to be dispersed unintentionally		N
C		*mechanisms*	7.02	Propagules dispersed intentionally by people		N
A			7.03	Propagules likely to disperse as a produce contaminant		Y
C			7.04	Propagules adapted to wind dispersal		Y
E			7.05	Propagules buoyant		Y
E			7.06	Propagules bird dispersed		N
C			7.07	Propagules dispersed by other animals (externally)		
C			7.08	Propagules dispersed by other animals (internally)		N
C	8	*Persistence*	8.01	Prolific seed production		Y
A		*attributes*	8.02	Evidence that a persistent propagule bank is formed (>1 yr.)		N
A			8.03	Well controlled by herbicides		
C			8.04	Tolerates or benefits from mutilation, cultivation or fire		N
E			8.05	Effective natural enemies present in Australia		

Weed type characteristic A= agricultural, E = environmental, C= combined

Figure 1. The Weed Risk Assessment Scoring Sheet with answers for *Kochia scoparia*. Details of the scoring process are given in Walton *et al.* 1998.

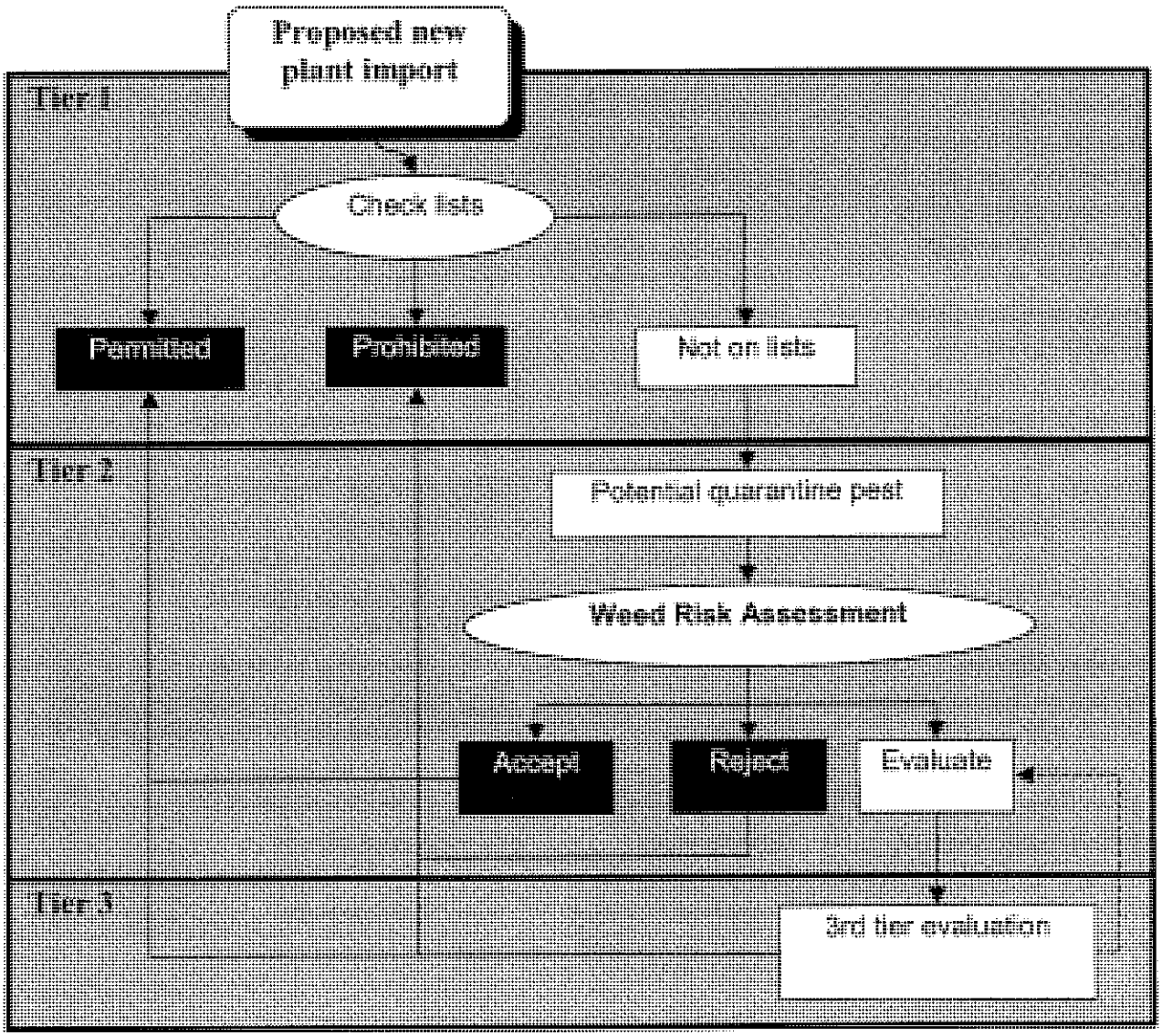


Figure 2 The three tiered process AQIS uses to screen proposed new plant introductions for weed potential.

Table 1. Weed Risk Assessment results for proposed new plant introductions. In addition to the principle outcomes of *Accept*, *Reject* or *Further Evaluate*, information on some taxa was too limited to make any kind of determination. For example, in some cases no published verification of the supplied botanical name could be found. Other taxa were found to be well established in Australia and thus could not be treated as a quarantine pest.

Result	Number assessed	Proportion of total assessed (%)
Accept	269	62
Reject	84	19
Further evaluate	48	11
More information required	33	8
Total	**434**	**100**

Table 2. Plant taxa rejected by AQIS using the weed risk assessment system.

Aconitum volubile
Acourtia microcephala
Adenostyles alpina
Ageratina adenophora
Ageratina aromatica
Agrimonia pilosa
Atractylis preauxiana
Babiana curviscapa
Bupleurum chinense
Cabomba aquatica
Carex lurida
Celastruc stephanotiifolius
Cirsium nipponicum
Colocasia esculenta
Corynephorus canescens
Crambe gigantea
Crambe sventenii
Cuscuta chinensis
Echium auberianum
Echium hierrense
Emilea flammea
Epilobium parviflorum
Eriophyllum confertiflorum
Eriophyllum nevinii
Erodium manescavii
Erodium cazorlanum
Eupatorium perfoliatum
Euphorbia hormorrhiza
Euphorbia pinetorum
Euphorbia restiacea
Euphorbia strigosa
Euphorbia colorata
Euphorbia pseudocactus
Euphorbia radians
Fibigia clypeata
Ficus lacor
Ficus natalensis
Ficus thonningii
Garrya veatchii
Harpagophytum procumbens
Harpagophytum zeyheri
Hazardia cana
Hemizonia clementina
Hymenocarpus circinnatus
Hypericum inodorum
Isoplexis isabelliana
Jurinea alata
Koeleria glauca
Lespedeza capitata
Ligularia japonica
Melia volkensii
Melica altissima
Melica ciliata
Molinia caerulea
Odontostomum hartwegii
Ononis sicula
Onopordon carduelinum
Onopordon nogalesii
Pachyrhizus erosus
Perideridia gairdneri
Pertya robusta
Porophyllum ruderale
Salix spp.
Sapindus mukorossi
Saussurea japonica
Schima superba
Spilanthes acmella
Stipa calamagrostis
Tabernaemontana coronaria
Teline hillebrandtii
Teline microphylla
Ulmus rubra
Uniola latifolia
Vitex quinata

Operational considerations

The three tiered screening system depends on understanding and cooperation from importers of plants.

- Inspectors generally must assume that the material is correctly described because the capacity within Australia to taxonomically identify exotic material, particularly seed, is very limited.
- Seeds are compact and easy to bring into Australia undetected, either deliberately or because of ignorance of quarantine requirements. Plants are available via international mail order, through printed catalogues or via the internet. Small parcels may pass through the mail exchange undetected, particularly if the label gives no indication of the contents. The risks from entry through the mail or on a person can only be met by a combination of increased community awareness and penalties. AQIS is currently undertaking an information campaign intended to address community awareness.
- Weeds can also be introduced as contaminants of other imported commodities such as commercial seed for sowing or consumption, on used machinery or travellers clothing. Effective inspection protocols are essential to manage this risk. AQIS is examining the inspection and

- sampling protocols currently in place to manage the risk of contaminants in imported commercial seed.
- WRA of a plant generally takes at least one day to complete on average and AQIS currently receives requests at about the same rate. In order to help ensure new weeds are not allowed into Australia while allowing the import of benign plants, AQIS must maintain this resource allocation. Cost recovery from the importer is not advisable because the benefit of the effort extends to all future importers of the plant and added cost would not encourage voluntary compliance with the requirements.

Take Home Messages

Many potential new weeds of Australia have been identified on the basis of substantial problems elsewhere in the world. The major weeds of production are reasonably easy to identify from published information and AQIS's permitted list system ensures that they are recognised on a case by case basis. Recognising other potential weeds of Australia, which may not have yet become weeds elsewhere or are the less well documented weeds of conservation, requires a more detailed approach and AQIS's WRA system attempts to achieve this.

ACKNOWLEDGEMENTS

Data reported here is the result of work by staff of the Plant Quarantine Policy Branch of AQIS. AQIS's protocol for screening plant introductions for weediness was developed and implemented with the support of Agriculture Western Australia and Natural Heritage Trust funding of the National Weed Strategy.

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THE REVIEW OF THE NOXIOUS WEEDS ACT

Graeme Eggleston
Program Manager(Agricultural Protection)
NSW Agriculture
Orange

PURPOSE

The review of the Noxious Weeds Act fulfils four requirements;
* A Statutory requirement that the Noxious Weeds Act 1993 be reviewed as soon as possible after 5 years from the date of assent of the Act which was 4 May 1993.

* The NSW Government's on going program of red-tape reduction and regulatory reform.

* The requirements of the Competition Principles Agreement which requires the review of laws which may restrict competition. It also wants to ensure that only laws which are effective, necessary and have a clearly-defined purpose, are retained.

* The National and New South Wales Weeds Strategies call for a coordinated approach, appropriate legislative, educational and coordinated frameworks in partnership with industry, landholders, water managers and the community

ISSUES PAPER

The review was required to assess the appropriateness of the provisions of the *Noxious Weeds Act 1993* on the basis of whether or not they restricted competition and, if so, whether they yielded a public benefit. A major element of this task was to determine the extent to which the objectives of the Act addressed instances of 'market failure'.

An issues paper for the review was drawn up addressing all areas where the Act impinged on public activity to find any evidence of 'market failure'.

Issues have necessarily been all encompassing, seeking consideration on a range of options including repealing the Act in its entirety, repealing or modifying particular provisions of the Act, leaving the Act in its present form, or introducing alternative arrangements that are more effective and less restrictive, while still facilitating management of weed problems in New South Wales.

The review considers the effect of the Noxious Weeds Act on other government legislation and the effect of other legislation on the control of noxious weeds. It asks the question, "Should legislation for noxious weeds stand alone or be integrated with other Acts"?

REVIEW GROUP

The Review Group was chaired by NSW Agriculture and was comprised of a representative from the Local Government Association, Shires Association, NSW Farmers' Association, Nature Conservation Council, Rural Lands Protection Boards, Total Catchment Management, National Trust and Department of Land & Water Conservation.

The Review Group prepared an Issues Paper outlining the review process and the key issues to be considered. The Issues Paper also included a summary of comments on the Act that had been received by NSW Agriculture since 1993. Summaries of the issues were provided to facilitate discussions by organisations.

Advertisements were placed in major metropolitan and country newspapers, inviting public submissions. Copies of the Issues paper were sent to all Local Government Councils, Rural Lands Protection Boards, NSW Farmers' Association District Councils, Catchment Management Committees and respondents to the draft NSW Weeds Strategy. The Issues Paper and related documents were also available from NSW Agriculture's Internet site. Meetings with key stakeholder organisations were held in Sydney on 27 and 28 July 1998.

RECOMMENDATIONS

Based on analyses of all comments received the Review Group has made recommendations to the Minister for Agriculture concerning weed control legislation for New South Wales. When the Minister has considered the recommendations, a range of proposals will be placed before Cabinet for approval and drafting of any necessary changes to the legislation. Local Control Authorities will be kept advised of these stages as they proceed.

TAKE HOME MESSAGES

A review of the Noxious Weeds Act has been necessary, both for statutory as well as a practical reasons. Many changes have been suggested by those who have forwarded submissions to the Review Group. The Minister for Agriculture will now consider the recommendations before putting a series of proposals to Cabinet for its endorsement.
Councils will be advised of the decisions when they have been approved.

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IMPLEMENTING STATE & REGIONAL WEED MANAGEMENT PLANS

Richard J Carter
Program Leader (Weeds)
NSW Agriculture, Orange NSW

INTRODUCTION

During the past two years we have seen a major change in the approach to the management of weeds in NSW. At the 9th Conference I challenged participants to take a new look at how they address weed problems. I stressed that we were not able to demonstrate success in weed control.

The Minister for Agriculture provided $6.4 in 1998-1999 to assist in noxious weed control. The Minister however wants to see results. The arrangements now in place link funding to outcomes. In this paper I will give an overview of the current planning process adopted by the Noxious Weeds Advisory Committee, and outline some of the outcomes that the process has enabled us to get.

Coordinating Weed Control

The New South Wales Government provides councils with funding for noxious weed control. More than $6.4 million per annum is targeted to assist local control authorities such as shires, municipalities and weed county councils to fulfil their statutory role in coordinating noxious weed control programs within their areas and on councils land such as roads.

The Government provides this assistance to:-

- provide a network of competent weed control coordinators.
- assist in providing quarantine protection by systematically surveying and inspecting land.
- provide the infrastructure for identification and rapid control of new weeds.
- maintain and improve the competency of weed control staff through continuing training and educational programs.
- minimize the spread of weeds from a local control area or region to other regions of the State.
- ensure best practice weed management is adopted.

Inspectorial assistance

Under the funding arrangements, grants are provided to assist councils coordinate weed control; conduct surveys; and inspect land within the control area.

This assistance goes to local control authorities to employ a weed control coordinators and weeds officers. The role of these officers is to:

- plan strategic weed management programs for the control area.
- integrate control programs with other activities within the region.
- conduct systematic surveys and inspections of land within the control area.
- maintain records and report on the distribution and abundance of noxious weeds.
- coordinate the implementation of weed management plans, including control programs of private landowners, the council and government agencies.
- implement the Noxious Weeds Act 1993.

Funding levels are based on the needs of the control area, based on the area, value of agricultural production, number of rural holdings and number of properties.

Treating high-priority weeds

In many cases the reality of what is achievable is quite different to the action specified under noxious weed declarations. Regional approaches to weed management are advocated to assist in coordination of the large number of participants involved in weed management. If the aim of providing State assistance for weed control is to minimize the spread of weeds from a local control area or region to other regions of the State a regional approach is needed.

Funding to assist councils control on roads is now linked to regional plans. Noxious weed control on roads is an important component of most weed control plans. Under the arrangements, councils can apply for *Operational Grants* to assist in the treatment of specific weeds on council roads and other land.

Priority is given to implementing agreed State and Regional Weed Management Plans. The plans run for three to five years.

Assistance of up to a dollar for each dollar contributed by councils may be provided for communication, education, training, publicity and treatment of specific weeds on local council land, waterways and roads as part of an approved State or Regional Plan. Assistance may also be provided to help implement local weed control plans.

In allocating assistance for each State, regional and local weed management plan, priority goes to plans where the assistance reduces over time rather than to plans requiring long-term assistance. We also look for plans where the current range and impact of the weed is small compared to the potential range and impact. Plans must be technically feasible, comprehensive, include a substantial contribution from local control authorities and use the most efficient long term weed control strategies. Plans must also be developed in close liaison with adjoining control authorities and public authorities.

In determining the level of assistance given, the advisory committee must consider the objectives of the program. Clearly plans that are feasible and if implemented will reduce the risk of a weed establishing in un-infested regions of the State have more support than controlling weeds that are already widespread. Good neighbour programs, where widespread weeds are cleaned up throughout a district or catchment, are valuable for a district, however give less benefit to the State than cleaning up those new isolated infestations.

Over time the aim is to have comprehensive management plans for all weed control assisted by State funds. Part of the process is to link declaration to plans. For several years all proposals for new weed declarations have been recommended to the Minister where the actions fits with a local, regional or state plans.

Cooperative arrangements

To encourage cooperative arrangements the Minister established the Regional Weed Action Program. Under the program funds of between $20,000 to $200,000 are available to groups of control authorities for short-term ,innovative projects. All projects funded under the program

must produce clearly measurable outcomes and have substantial contributions from participant control authorities.

Preference is given to projects that have regional or State benefits and that: address issues raised in the New South Wales Weed Strategy or the National Weeds Strategy. Projects that develop regional weed management plans, address emerging weed problems of potential major significance, demonstrate new approaches to coordinated weed control and improve the skills base of local control authorities are funded.

Projects funded under this program have developed weed management training for local government, employed regional coordinators to work with councils to develop regional plans, and investigate improved mapping and recording systems.

The changes already evident as a result of the new funding arrangements include an increase in the number of full-time equivalent weed officer employed by local control authorities from 87 in 1996-97 to 105 in 1998-99. The majority of the State is now served by one or more regional advisory committees. The funding arrangements has also resulted in groups of councils, public land managers and community groups developing regional weed management plans to target weed control actions.

The NSW Weeds Strategy highlights the need for competent weed control staff. The regional planning process has made it clear that where weed officers were skilled at planning and consultation the planning process is easy. Where councils have not adequately trained weed officers, or expect spray operators to do planning, the process is much more difficult. Fortunately most regions have skilled staff. To build on the skills already there NSW Agriculture has facilitated a series of skills workshops.

TAKE HOME MESSAGES

We are progressing and now for the first time grant funds are provided on outcome based projects. As councils recognise that funds are only available to meet planned outcomes, and weed officers gain skills in planning and designing district and regional programs, we will begin to tell Government what we have achieved and demonstrate our success

SIAM WEED IN FAR NORTH QUEENSLAND

Mission Impossible???: The eradication program so far.....

Reece Luxton
Land Protection Officer
Department of Natural Resources, South Johnstone

BACKGROUND

Chromolaena odorata (Siam weed) is one of the world's worst tropical weeds. Michael (1988) and McFadyen (1989) identified the potential for it to invade Northern Australia and its ability to substantially reduce pasture production, interfere with tropical crop production and compete with native riparian vegetation of high conservation value. Siam weed became a primary target for weed surveys conducted under the auspices of the Commonwealth-funded Northern Australia Quarantine Strategy (Hardwick and Waterhouse 1996), particularly due to its pantropical distribution.

For the purposes of pre-empting its arrival, Siam weed was declared P1, P2 for the state of Queensland under the Rural Lands Protection Act 1985.

Barbara Waterhouse, AQIS botanist, subsequently found an infestation on 15 July 1994 in the Bingil Bay area, 120 km south of Cairns, Queensland. Within days action was taken, with staff from the Department of Natural Resources (formally Department of Lands) Land Protection Branch and assistance from other industry bodies such as Tully Cane Protection and Productivity Board locating and controlling the majority of known infestations.

As eradication was determined as feasible, funding was sought and subsequently approved from the Standing Committee for Agriculture and Resource Management (SCARM) for a five-year eradication program. The Federal Government funds 50% of the program, 25% from Queensland and the residual paid by those states where Siam weed was thought to have a potential impact.

The likely mode of introduction was through introduced pasture legume and grass seed from Brazil, sown in the vicinity of Echo and Davidson Creeks in the late 60's/early 70's (Hardwick and Waterhouse 1996). This conclusion can be drawn from the presence of two different genotypes present in the area – the common type is widespread, whereas the second genotype originates only from southern Brazil.
This has been supported through anecdotal evidence of landholders in the area.

INTRODUCTION

Potential distribution

Siam weed is a native of Central and Southern America, and has spread throughout the majority of tropical and subtropical countries of the world. It is still spreading rapidly, particularly through the Philippines, south-west China and South Africa. Especially worrying is its spread in our near neighbours Papua New Guinea and eastern Indonesia (DNR 1997).

Siam weed is particularly suited to highly productive land types where annual rainfall exceeds 1,000 mm per annum. In Australia this would be throughout coastal Queensland, New South Wales, Northern Territory and northern Western Australia. It is unlikely Siam weed would extend far inland over much of this range, but it can extend into the monsoonal tropics of the Cape York Peninsula and the highland areas of northern New South Wales.

Description

Siam weed looks very similar to blue top or billy goat weed (*Ageratum spp*), but has a growth habit similar to lantana. The leaves are soft green, triangular in shape and have distinctive three-vein pattern. When mature the plant becomes extremely woody, and regrowth can occur rapidly after fire or slashing. The plant forms flowers in May and October producing masses of pale lilac flowers. The seeds are small and brown and have tiny barbs that stick to clothing, animals and can be carried by wind, water and machinery. Of primary concern is that a single plant is capable of producing 87000+ seeds/year and this has obvious implications for a seed bank, especially that derived from heavier infestations.

Where is it?

The major infestations of Siam weed are located on the pastoral property adjacent to Echo and Davidson Creeks, tributaries of the Tully River. The infestations occur predominantly along rainforest and riparian margins, where it can scramble up scrublines. Adjoining properties to the Tully River have a similar situation along with isolated plants extending 30 kilometres to the tidal reaches.

The infestations at Bingil Bay are located on various properties and roadside situations, with isolated infestations subsequently discovered at various sites in the area, particularly El Arish – 6 properties, Japoonvale – 10 properties, Granadilla – 2 properties, South Mission Beach – 1 property and Feluga – 3 properties.

During a control program run by SWEEP for rubber vine, a staff member identified a plant located 50 kilometres to the west of the Echo Creek infestations. Found on a pastoral property in the Mt Garnet area, it is unknown how the plant got there – but it reinforced the need for staff outside the known areas to be able to identify it.

The main crops in the area where Siam weed is present are sugar and banana crops. These primary producers do not consider Siam weed as a threat to their crops as they are carrying out herbicide control programs as a part of normal farming practices. However where Siam weed exists in the riparian areas, the farmers do not utilise these. There is no direct economic disadvantage for the farmers.

What's happened so far?

In 1995 Land Protection Branch staff from around the state were again utilised for a number of follow up programs. Extension was ongoing. The program in 1996 was run operationally through the Strategic Weed Eradication and Education Program (SWEEP), using two full time staff to carry out ongoing control and survey. The shift to utilising local staff in 1997 brought a decrease in expenditure and an increased knowledge of Siam weed in the area.

This year will have been the fifth year of the eradication program.

The eradication program on Siam Weed continues to progress well with staff now consulting with landholders to ensure they capitalise on successes to date. Agreements are now being sought from landholders to control isolated infestations and to control grasses along headlands and other areas where vegetation growth hinders control and inspection operations.

THE ERADICATION PROGRAM

The eradication program has consisted of three phases:

1. initial control and survey – 95% infestation reduction
2. the spraying of seedling regrowth – follow up programs
3. monitoring and eradication of scattered seedlings and adult plants for an extended period

The funds are utilised three ways – the main proportion is contributed to continued surveying and control, with the other objectives being research into ecology studies, appropriate control measures, and extension and awareness.

The Department has been successful in securing a further 2 years funding through SCARM to allow further work to continue on the eradication program. With the Siam Weed Consultative Committee drawing to a close, it is imperative that stakeholders in the program be involved in a steering committee to continue the program.

Control/survey work

The two full-time SWEEP officers are fully employed on the Siam weed program, undertaking monitoring known infestations, conducting surveys, responding to reported infestations, training local council personnel in respect of possible machinery contamination and raising public awareness. During peak activity periods, additional control teams are utilised, using local labour, which has flow-on effects to public awareness levels. The level of Local Government support is encouraging from both Cardwell and Johnstone Shire Councils, with dedicated time provided by the respective Weeds Officers and a high level of cooperation from machinery operators—both of which feed into local "ownership" of the program. Local landholder support is generally of a high standard and the active co-operation of the property owners of Tully River Station has been very useful—but monitoring programs will need to be continued to overcome areas of "inertin culture".

With the discovery of a number of geographically dispersed infestations, the need to regularly revisit known locations, and the extended flowering period caused by the second phenotype, the control workload has increased over the last two years (see Table 1). It is worth noting that while actual spray volumes on some of the earlier infestations have decreased, the converse is true for time expended in locating seedlings in these areas.

Table 1 **Summary activities 1994 – 1998**

Timing	Activity or milestone	Person days
1994/95		
July/August	Initial control program, removed approximately 95% of established plants.	130
November	Follow-up program (2nd) and removal of residual 5% of established plants and 80% of seedlings that had germinated since July/August.	60
April/May	Control program (3rd) removed remaining 20% of old seedlings and 90% of new seedlings.	300
	TOTAL	**490**
1995/96		
July	Control program (4th), only one long-established plant found, seed set appears to be 25 days from flowering.	117
October	Control program (5th), differences in flowering period observed.	75
May	Workshop and site inspections, Mission Beach for Consultative Committee members and government officials.	-
May/June	Control program (6th).	223
	TOTAL	**415**
1996/97		
July/August	Follow-up program (7th).	182
Oct/Nov	Control program (8th).	186
Jan-Mar	Monitoring and follow-up (9th).	72
April/May	Survey by boat and helicopter, control program (10th), secondary infestations identified by helicopter in riparian areas.	80
June	Main spray program (11th).	150
	TOTAL	**670**
1997/98		
July-Sept	Follow-up program (12th) surveys Mt. Garnet.	165
Oct/Nov	Control program (13th) on main and second phenotype.	71
February	Field day organised at M. Porters farm; follow-up on reported infestations.	50
March/April	Control program (14th) on second phenotype; setting-up of seed longevity trials; 'Caravan Hill' discovery.	80
May/June	Main control program (15th); helicopter surveys; workshop and site inspections (Tully River Station and Bingil Bay) for Consultative Committee members and government officials.	165
	TOTAL	**531**

The staff involved in the program had to work in extremely inhospitable conditions during the course of the program. From the humid tropical climate associated with an area that receives 3.5 metres of rain annually, to the hazardous plants and animals that are likely to be confronted , the staff have relentlessly gone about their work.

The control program was refined and adapted as new information became available. For example, the shift to sourcing local staff allowed the expertise and knowledge to stay in the area. Also, control p

eriods were extended by two months in localities where both genotypes were present. Field activities were most intense during the plant's flowering period, with a diverse range of activities occurring at other times.

A helicopter survey conducted in 1997 and 1998 during the plant's peak flowering period confirmed the locations of infestations limited to known areas. Although it seemed quite expensive, it proved invaluable in identifying sites normally deemed inaccessible. The ability to cover more ground in a shorter period of time was also advantageous.

Surveys conducted between control programs by the full-time staff have found a number of isolated plants away from the main sites. The infestations are still within a 50 kilometre radius of the initial discovery at Bingil Bay, with 95% regarded as new discoveries less than 5 years old and within the same catchment area. Subsequently the spread of Siam weed since 1994 can be regarded as minimal.

Physical removal of Siam Weed is now possible at particular sites where the seed bank is likely to be exhausted. It is also the preferred option where infestations exist on organic farming properties. The use of glyphosate-based herbicides to control large grass species to provide ease of access has assisted control staff, along with having the benefit of cleared sites to return to.

The use of global positioning system (GPS) units and a corresponding Geographic Information Systems program has been invaluable. Staff has utilised the benefits of this technology to locate infestations which have proved difficult to relocate. It has been a massive task to record the sites, not just to the property but the actual location on the property. The end result is that those new to the program pick up the locations much easier.
The length of the control program is dependant on weather conditions and variations in the plant's growth habits.

Ecology work
The Tropical Weeds Research Centre at Charters Towers has conducted several studies into the ecology of Siam weed since it was discovered. Soil seed store under and near dense infestations were investigated, with results indicating that most seed falls near the adult plants, despite the seed having a pappus. The germinablility of seed after various amounts of time in various conditions was also studied.

Soil was placed either in dry storage, on the soil surface, or buried 2cm deep in the soil. Germination tests were performed after 0,1,3,6 and 12 months. Results showed that germinability was highest in the dry-stored seeds. After 12 months, only between 1 and 6 % of the field-stored seeds germinated under test conditions, however many more appeared intact and healthy and may well have been viable but in some form of dormancy. Further studies are required on the longevity and dormancy of Siam Weed Seed.

Overseas results demonstrated buried seeds could remain viable for a minimum of 2 years (Hardwick and Waterhouse 1996), but experience gained from the North Queensland infestations has shown that a few seedlings are still appearing in treated areas after 4 to 5 years. The eradication program as such will be expected to continue longer than the five years allocated, with consideration to mature plants which may have missed detection and also newly identified

infestations during the program. There is evidence in the field of seedlings returning 3-4 years after initial control programs.

Flowering has been observed to occur twice in the last two years, with the likely reason that the infestations here are corresponding to asynchronous flowering similar to that which occurs with infestations in Papua New Guinea and Irian Jaya (Cshures 1994).

Extension work

The potential for positive contributions to the program by the public has long been recognised, but extension programs designed to tap into that resource had to wait until procedures and person-power were in place. A start was made in 1996/97 with networking of existing community groups. The extension program was further expanded in 1997/98.

The extension program undertaken by DNR aims at all levels of Government, locally and state wide, industry bodies and individual landholders to understand the importance of this weed and the need for its control.

The factors influencing the extension program include the fact the plant is not readily seen in the local environment, and as such is not deemed a problem. Also, Siam weed is considered a 'government' weed, and people don't fully understand why it is a problem. However, some positives to the program include that it is contained to a relative small area, the plant is relatively easy to kill with herbicide and general awareness of weed exists from previous extension.

Successes in the program locally include new infestations being reported by general public, landholders committing themselves to specific actions to assist with the program, other organisations assisting with education in identification, and all Local Government Pest Control officers are able to identify Siam. Queries at 'Weed' activities in North Queensland to date indicate more than 50% of those attending are aware of Siam weed. Over 500 people in other government departments are now trained in identification of Siam weed. Education of landholders and industry bodies are still deemed invaluable in providing information on isolated infestations.

At present landholders have been extremely obliging in allowing control teams to work through their properties. Appropriate extension through various media allows for communication of the operational part of the program.

Prevention

The spread of Siam weed is inevitable, due to the abundance of seed that can be easily moved by wind, water, animals and machinery. Measures have been taken to prevent weed seed threat – staff are involved in ensuring vehicles and machinery are washed down after working in an infested site. For example, public utilities such as Telstra, electricity boards and local government vehicles have been complying with requirements set down by DNR. Furthermore guidelines have been developed for the movement of sand and gravel from extraction sites on the Tully River.

In order to identify how Siam weed has been distributed, staff have been involved in tracing the past movements of excavation equipment, timber extraction and stock throughout the local area. This has subsequently led to identifying infestations away from the known areas.
In 1997/98, a plant with strikingly similar flowering characteristics to Siam Weed was observed at 'Caravan Hill' off Davidson Rd; identification of this plant from Kew Botanic Gardens, England

has been sought. Caravan Hill, 5 kilometres south-east of Tully River Station, is the site of the initial clearing which took place on 'King Ranch' in the mid 1960's and is close to paddocks broadcast with the first seed from South America.

An approach to use Siam Weed for researching and developing medicinal purposes was forwarded from a Sydney pharmaceutical company recently. This was not approved, as utilisation of any P1/P2 plant will not be considered, particularly when eradication is the target. The goals of eradication and use as a resource are mutually exclusive objectives.

WHERE TO FROM HERE??

We are now in the most important part of the eradication program – known areas are treated and constantly monitored by the two full-time staff, however vigilance by stakeholders is the key.

Eradication of the species is the main goal, however to achieve that there is an ongoing requirement for prevention of further seed production. It is expected that staff will go to the extent of removing all flowers from those sites with low infestation levels. The material will be appropriately disposed of using autoclave facilities at South Johnstone.

At the last Siam Weed Consultative Committee meeting in May 1998, the project was regarded as going extremely well with this message being relayed to all and sundry. Subsequently funding for a further two years to continue the program has been sought and approved. The program as such will certainly not end right there and then. Constant monitoring of sites will be ongoing by appropriate staff for many years yet especially at the sites only identified recently.
The program is to be managed under the Australian Weeds Committee under its incursion management role.

TAKE HOME MESSAGES

A shift in resource levels was indicated during the course of the program. The trend of large herbicide usage and time spent spraying has changed to more time now spent seeking the plant. The subsequent costs for a program similar to this will need to take this into account.

The commitment of dedicated staff is the key. Without the support of these personnel the program would not have been as successful as it has been to date. Landholder commitment and assistance is necessary, but eradication could only be regarded as achievable because a government department was responsible for conducting on-ground control program.

With evidence in the field showing seeds lying dormant in heavily grassed areas, and no hard data to date of the actual seed viability of Siam weed, the eradication program is delicately balanced. It may come as no surprise to finding plants ten years from now. Hence it is imperative to ensure that ecological studies are in place from the start to provide good background data to base sound decisions on. Overseas information is just that – what occurs there does not necessarily mean it will occur here. The relevance to local infestations is quite subjective.

Although the main characteristics of Siam weed are known, there are many areas which need clarification if a similar control program is to be accurately tailored in the field.

While there have been no reports of infestations elsewhere (neither in Queensland nor in other states), it would be imprudent to relax vigilance. Utilising staff from other areas of the state and

interstate is of great benefit to provide training on identification of potential pests like Siam weed. Aerial surveys and increased landholder participation are key elements in finding and eradicating Siam Weed infestations.

There are substantial grounds for believing that eradication will be achieved, but with the emergence of information about seed longevity and the existence of at least two phenotypes, then this may take longer than originally anticipated.

Therefore:

1. eradication is only possible if there is continued follow up to ensure no plants are allowed to further seed.
2. the program will require ongoing monitoring and control or enforcement of control for up to 10 years.

Acknowledgments

My thanks go to all who have been involved in the eradication program to date – whether spraying the trifid in the deep dark depths of Tully or assisting with spreading the good word for eradication. Particular appreciation is extended to Owen Zeimer, Diana O'Donnell, Melissa Keir – Department of Natural Resources South Johnstone, Russell Edwards - Tully Cane Protection and Productivity Board, and Barbara Waterhouse – AQIS Mareeba, who strives to keep me honest!

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FIREWEED, A COMMUNITY DIVIDED

Ian Borrowdale
Chief Weeds Officer
Shoalhaven City Council, Nowra

INTRODUCTION

The Shoalhaven used to be a pleasant place to live with beautiful beaches picturesque mountains and thriving farms.

Then during the early 1980's a foreign invader entered this tranquil area. Nobody really noticed it a first, it was just a little green bush with yellow flowers that sprung up in the winter after some hay from the north coast had been imported during a particularly dry period and fed out to stock in the local area.

In about mid 1980 some concerned person identified this plant as Senecio lortus, which is native to Australia. During the 80's this plant continued to spread much faster than would be expected of a native species with its usual predators and disease.

About this time I started work with Shoalhaven City Council and alarm bells were beginning to ring in the farming community, dutifully I sent a sample to the Herbarium in Sydney and the plant was positively identified as Senecio madagascariensis or Fireweed.

THE PROBLEM

The frightening thing about this plant is its ability to reproduce and spread at an alarming rate (like fire), a good healthy plant produces up to 200 flowers (per plant) during its life cycle and each flower has the potential to produce up to 35,000 seeds, which are light and easily dispersed over a very large area by the wind. In good soil with little competition Fireweed has the potential to produce plant densities of 500 plants per square metre, Shoalhaven City comprises 4,600 square kilometres, 40% of this area is cleared and arable and has the potential to grow Fireweed. My calculator gave up when I tried crunching numbers of this magnitude, the potential for the spread of this plant is mind boggling. Moisture and lower temperatures trigger germination of the seed, although trials have shown that Fireweed can germinate between 15 degrees Celsius to 27 degrees Celsius. This effectively means that Fireweed could germinate over most of the year, although, experience on the south coast has shown most of the germination occurs from April to September.

Plants can produce flowers from 6 to 10 weeks after emergence and the seed is capable of germination immediately after they are released from the flower head, so this plant has the potential to produce several generations in one season given favourable weather conditions. I have seen four germination's of Fireweed spread across a full 12-month period occur on the south coast.

Normally the plant assumes an annual life cycle, however, it is so adaptable that given a good season it can continue to grow in a perennial mode after producing one lot of seed and go to seed again or if a period of extreme temperature or lack of moisture occurs part way through the plants

growing season, the top growth of the plant may die back and it will shoot again from the roots once a favourable season returns.

Fireweed is typically prevalent in second class country or areas that have been neglected or over grazed. It detests competition and one accepted method of control is to establish and maintain a vigorous, dense pasture, having said this, I have seen Fireweed plants growing happily in dense Kikuyu pasture during spring and summer.

Fireweed plants produce Pyrrolizidine alkaloids, which are toxic to animals, this chemical causes liver damage in animals that ingest a reasonable amount of Fireweed over a given period. All growth stages and all parts of the plant contain these toxins, and the most dangerous time for this type of poisoning to occur is usually during an early onset of winter or a late germination of Fireweed amongst a spring flush of pasture growth. At these times the Fireweed plants are small and stock cannot help but graze some of the Fireweed plants. Another major problem is that Fireweed remains toxic whether green or dry, so hay and silage containing Fireweed can also be toxic to animals and the preservation of fodder by these methods also make Fireweed more palatable to the animal.

We have reached the point in Shoalhaven, where some farmers, in areas not infested with Fireweed, refuse to buy cattle or hay or silage from known Fireweed areas. When Fireweed plants begin to mature stock tend to graze around them, as the plants have a pungent odour and bitter taste. However, during an extremely dry winter, Fireweed may be the only green plant available in pastures, and some stock will most assuredly nibble at these plants.

The toxins in Fireweed have a cumulative effect, resulting in death, however, the length of time taken to reach this stage is dependant on the amount of Fireweed ingested and the period of time. Usually symptoms manifest themselves in the animal similar to many other diseases or just plain ill thrift, and many cases of Fireweed poisoning on the south coast are put down to other causes such as intestinal parasites, liver fluke, mineral deficiencies or just a poor season.

There is no treatment for Fireweed poisoning, the only way to reverse the effects of Fireweed is to reduce the quantity of Fireweed in the animals diet. Cattle and horses are very susceptible to Fireweed poisoning, as are young hungry stock. Sheep and goats are much more resistant to Fireweed poisoning and where these animals are grazed with sufficient stocking numbers, Fireweed is effectively controlled in the pasture.

CONTROL

We have all heard the catch phrase "integrated management" and no truer words were spoken in relation to the control of Fireweed, we have farmers in the Shoalhaven that have been spraying every year for the last ten years, and have achieved a high level of control, all be it at great expense, however, should these farmers miss one or two years, the amount of seed in the air would rapidly reinfest these areas. The main management practices are not to over graze and to build up a vigorous, dense, pasture. This is all very well on prime country, however, as Fireweed readily infests second grade country in our area, this type of management is not always economically feasible.

In lightly infested areas, hand pulling is the most popular method of control. Plants are pulled out by hand, placed in plastic shopping bags, allowed to dry out and either buried or burnt. If infestations are more wide spread and dense spraying with a contact herbicide, such as Bromoxynil seems to be the only alternative. At about $44.00 a hectare, cost for this type of chemical and the necessity to spray up to 3 or 4 times per season, this type of control is quite expensive, particularly, on second grade country where income producing potential is low.

THE BATTLE

Once Fireweed had been positively identified, Council instigated a series of public meetings to decide how we should go about controlling this plant. The meetings were very well attended because everyone had seen the dramatic spread of this plant and were very concerned. A meeting in the north of the City attracted landowners and Councillors from neighbouring Shires and this is where our first battle began. Representatives from Kiama Shire to our north had been battling Fireweed for a few years before it became entrenched in Shoalhaven. It had spread so quickly on second class country that they had given up the fight and advised us to do the same. Councillors from Shoalhaven and Kiama held a very heated debate and had it not been for the Regional Director of Agriculture's intervention, I think we would have had a brawl in the middle of the meeting room.

After much procrastination, Shoalhaven Council was successful in having Fireweed declared a noxious weed in the Kangaroo Valley area. The declaration was confined to this area to help protect the lucrative and expanding Kangaroo Valley rye grass seed industry. This direct declaration worked quite well and Fireweed was kept out of the Kangaroo Valley due to the determination of the community and the natural wind break formed by the mountains that prevented the ingress of seed from surrounding areas.

Of course, the debate over whether the rest of Shoalhaven should have Fireweed declared noxious, raged, with Council, the local press and the beleaguered Chief Weeds Officer being bombarded with letters, petitions and representations arguing the case both for and against in about equal strength.

At last in 1993, Council succumbed to the pressure of a 3000 signature petition, requesting Fireweed to be declared a noxious weed throughout the city. As this declaration coincided with the introduction of the new Noxious Weeds Act, and more importantly the categorisation of weeds into control categories, a W3 declaration was applied for, as by this time Fireweed was completely out of control in the central Shoalhaven area. This of course only pleased about 50% of the community and the 3000 people who had signed the petition. The W3 category was seen as a way of managing current levels of Fireweed whilst attempting to prevent its spread to other areas. Unfortunately this theory didn't work in practice and Fireweed slowly crept into Kangaroo Valley and the southern Shoalhaven.

After more representations from farmer groups in these areas, Council decided that the only way to prevent Fireweed from entering these areas was to change the category back to W2, so again we have the phenomena of there being two control standards within the city, this brought on a fresh bout of letter writing and representations from the community, again divided 50/50 as to what they wanted to see happen.

Fortunately, Council has stuck by its decision and these declarations have been reasonably successful in preventing the spread of Fireweed into the Kangaroo Valley and southern Shoalhaven areas, whilst the rest of the Shoalhaven in the W3 category has held its own.

It always makes for a lively debate when I try to explain to a property owner in Kangaroo Valley if they are being fined for not controlling a small amount of Fireweed plants whilst their friends a couple of kilometres away on the other side of the mountain have acres of it and allowed the cheaper control method of slashing rather than spraying.

THE AFTERMATH

Council is determined to carry on the fight against Fireweed and every winter I put on my steel helmet and flack jacket and venture in to all areas to do battle with this foe. Like most gorilla warfare you are never quite sure which part of the population is for or against you.

In closing spare a thought for one poor beleaguered land owner on the northern boundary of Shoalhaven City who's farm is cut in half by a creek, where the area north of the creek is in another Shire, whilst the area south of the creek is in Shoalhaven and of course Fireweed is not declared noxious in the northern Shire.

CABOMBA MANAGEMENT ATTEMPTS IN QUEENSLAND

T.Anderson and G.Diatloff
Department of Natural Resources
Alan Fletcher Research Station
PO Box 36, Sherwood, Q 4075

INTRODUCTION

Cabomba, *Cabomba caroliniana* Gray is a difficult and costly aquatic weed to manage in our environment. A conservative estimate of money spent on cabomba in Australia recently would be well over $1million.

This paper outlines our experiences with cabomba control in two south-east Queensland potable water storages, namely, the Ewen Maddock Dam and Lake Macdonald.

Infestation profiles of the dams are outlined in Table 1

Table 1.

Dam	Ewen Maddock	Lake Macdonald
Water supply for	Caloundra City (backup)	Noosa shire
Storage capacity	17,000ML	9,280 ML
Cabomba first seen	Nov 1993	April 1992
% infested then	1.5%	40%
% infested 1999	25%	72%
Management aims 93-96	Eradication	Containment

Ewen Maddock Dam

Early detection of cabomba by weed supervisor Mr. P. Bell provided a 'once only' opportunity to eradicate the pest before it spread. It must be stressed that in 1993 there was very little information on cabomba's biology or its control. An integrated control strategy relying on a combination of weed enclosure, drawdown of water levels, physical removal and chemical control was approved by Caloundra City Council.

A weed eradication program is unlikely to succeed without the careful use of an appropriate herbicide. Finding a strategic spot spray treatment to control critical infestations of cabomba was essential.

A series of laboratory screening and efficacy trials revealed the following chemicals did not control cabomba: amitrole, copper sulphate, dicamba, dichlobenil, dichlorprop, diquat, fluridone, endothal sodium and potassium salts, fosamine, glyphosate, metsulfuron methyl, 2,4-D dimethyl amine salt and 2,4-D ethyl ester.

Active molecules included bromacil, diuron, hexazinone, 2,4-D acid and 2,4-D n-butyl ester. The best spot spray chemical was the n-butyl ester of 2,4-D.

Traditional approaches to aquatic weed control had not worked against cabomba. Poor herbicide uptake and dissipation problems were overcome using a mixture of 2,4-D n-butyl ester and diatomaceous mud.

From February 1994 to May 1995 the cabomba infestation (1.5% of the dam surface) was treated with 1100 L of 2,4-D n-butyl ester, applied at 11ppm active, delivered through weighted submerged nozzles.

Despite publicity in print and TV media, shopping centre displays and field days the eradication efforts became embroiled in public controversy. For political reasons the project management team decided not to use anymore chemicals after February 1996.
The control focus changed from one of eradication to one of containment-type management.

Our experience with cabomba highlighted the credibility gap that exists between government agencies and the public.

In regard to the aquatic herbicide used, it should be noted that:
- the method destroyed cabomba effectively,
- exhaustive analysis by the Australian Government Analytical Laboratories in Melbourne found no trace of 2,4-D in water or soil
- the areas that were treated are still relatively free of cabomba.
- no wildlife deaths were attributed to the spray program.

Approximately $400,000 was spent up to 1996 on cabomba control and research. Since then $160,000 per annum has been spent on manual removal using scuba divers.

Cabomba is relatively easy to pull out. So far the diving exercise has kept the infestation at an acceptable level (R Rainbird pers. comm.).

Lake Macdonald
Cabomba was first noticed on Lake Macdonald in April 1992. By 1994 the native underwater plant community had been destroyed by cabomba. In the last five years of diver sampling no submerged native plants have been recorded from Lake Macdonald.

Weed supervisor Mr.K.Garraty organised an information day bringing together all interested parties along the 300km Mary River system. The outcome was the formation of a working group and acceptance of a 'Cabomba Action Plan' by Noosa Shire Council.
The plan's goal is to manage the impact of cabomba on waterways. Its objectives are to prevent the spread of the pest to other waterways, to reduce the infestation in Lake Macdonald and to enhance the existing stream and bank vegetation.

Upgrading public facilities at boat ramps is a positive management initiative. Boat trailers spread cabomba. Concrete boat ramps would reduce the possibility of boat trailers carrying the plant. Signage identifying the plant and wash down facilities are improvements that will help reduce cabomba contamination of other dams.
An ongoing research program at Lake Macdonald has investigated mechanical harvesting, drawdown and cabomba biology. In 1998 the summer standing crop of cabomba was averaging 71 tonnes ha^{-1}. The water volume displaced was 85,805 L ha^{-1}. Cabomba composition is detailed in Table 2.

Table 2. Cabomba analysis and nutrients removed by harvesting at Lake Macdonald.

Composition	Cabomba	Quantity harvested (kg ha^{-1})

Protein %	13.3	1,395
Nitrogen%	2.13	226
Phosphorus%	0.17	18
Potassium%	1.77	188
Calcium%	0.53	56
Magnesium%	0.22	23
Sulphur%	0.41	43
Sodium%	2.17	231
Chloride%	1.27	135
Copper mg/kg	12.0	0.12
Zinc mg/kg	73.0	0.78
*Manganese mg/kg	5,400.00	57.4
*Iron mg/kg	19,000.00	202
Boron mg/kg	63.3	0.67
Loss on ignition %	68.0	

*High levels probably due to a complex of epiphytic microbes.

A field harvesting exercise proved that cabomba lends itself well to harvesting. Following cutting the cabomba infestation grew back to preharvest density within 3 weeks. During this time a significant improvement in water quality parameters was recorded.
In both the Ewen Maddock dam and Lake Macdonald, underwater obstacles such as timber, fences and bridges interfered with field operations. For future harvesting to be an efficient management tool it would be necessary to remove underwater obstacles.

Drawdown.
A severe drought at the end of 1994 caused water levels in Lake Macdonald to be drawndown by 1.2 m. As the exposed cabomba infestation dried out 60 plant bases were tagged. Ten weeks after reflooding divers located 36 of the 60 tagged plants. None of the tagged bases had regrowth. However, free floating cabomba fragments (30 cm. in length) originating from plants in deeper water reinfested the drawdown area within 10 weeks to a density of 3 plants per m^2. 100 random grapple samples from the area scored 55% live cabomba hits. Clearly, drawdown by itself would not provide long term control of cabomba.
In an integrated pest management strategy drawdown is a very useful method of killing cabomba in shallow areas. Also it reduces the area of infestation needing further treatment.
However, water supply engineers often oppose drawdown as they prefer to keep dams brim full.

The Lake Macdonald cabomba infestation regularly breaks up into fragments capable of colonising new areas. Surprisingly, after 7 years of frequent flooding cabomba has only spread about 500m. downstream. One explanation for this could be the filtering ability of the downstream bank vegetation. Protection of flood plain scrubs is an important management goal.

Approximately $85,000 has been spent since 1992 on containment measures and research.

Cabomba laws.
In 1990 cabomba became an illegal plant in Queensland when it was listed in the declared plants schedule of the Rural Lands Protection Act 1985. The main thrusts of declaration were to prevent the pet industry marketing cabomba and to help stamp out deliberate commercial cultivation in public waters. To effectively eliminate any cabomba trade, pest plant laws need to be uniform for all

States. 80% of water plants grown in Queensland are sent south. While declaration was a positive step and done with the best of intentions, it has a major fault. Soon after removal of cabomba another submerged exotic *Egeria densa* (dense waterweed) filled the void. In the last few years Egeria has been deliberately grown in public waters and unfortunately it appears as invasive as cabomba.

Take Home Message

Cabomba is believed to originate from Guyanna, and is a serious threat to Australian waterways. There are few management options available and these are not practical or suitable in sensitive water situations. One aim of this paper is to highlight the futility of short term, quick-fix control methods and to support long term solutions such as classical biological control. Biological agents have successfully managed other South American water pests such as water hyacinth and salvinia. The only unexplored management method which offers an environmentally acceptable avenue is biological control.

Acknowledgments

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WILLOWS A MENACE OR MANAGEMENT OPTION ON WATER COURSES

Robert Trounce
Weeds Agronomist (HO)
NSW Agriculture Orange

OVERVIEW

Willows are members of the genus *Salix* and are not native to Australia, but have been introduced mainly from Asia and Europe. Some species of willow offer unique and valuable properties for uses such as protection of river banks, timber, fuel, fodder, shade, shelter, basket making, bee forage and aesthetic landscaping, if planted in the appropriate place.

The first willow varieties imported into Australia were either entirely male or entirely female and were rarely planted close to a compatible partner to produce viable seed. New trees were propagated solely by cuttings making their offspring genetically identical to the tree they were taken from. Occasionally inadvertent reproduction occurred by broken branches falling into water courses and taking root, often some distance away from the parent tree.

In recent years and particularly over the last two decades, new imports of willow varieties have included species which more readily cross pollinate with trees already growing in Australia, or even produce viable seed themselves through self pollination. This form of reproduction allows release of millions of seeds which are distributed long distances by wind or water. They take root on sand banks, sometimes literally forming forests or thickets which are capable eventually of blocking the flow of the stream by build up of debris and sediment.

Regeneration of willows from seed depends on the production of viable seed, as well as favourable conditions as seeds fall. The seed is short lived (one to two weeks) and the seed bed must be continuously wet for a few weeks or months as the roots grow very slowly. However, some willows (such as Black willow or grey sallow willows) will even establish in moist forest environments.

To prevent further willow invasion it is necessary to stop planting new and different varieties of willow which may produce seed either themselves or by cross pollinating with existing willows.

Some willows may still have a place in the Australian environment, but it is strongly advocated by many experts in ecology and botany that the natural spread of willows along streams should be halted. To do this it is necessary to understand how the trees grow and reproduce, identify the species and remove those which are causing problems.

It is not intended to condemn all willows and call for their removal. The maintenance of many willows, especially weeping willow (*Salix babylonica*) along some water courses is critical for bank stability. In fact it is emphasised that a thorough study of the trees growing along the stream should be made to assess what the likely effects might be if any tree is removed or left growing. A suitable option may be to kill willows which are producing seed or blocking water flow and replace with alternate vegetation to maintain bank stability.

Legislation such as The Native Vegetation Act, concerning removal of vegetation near streams should also be studied before commencing any project, with discussion, where appropriate, with officers of the Department of Land and Water Conservation.

Identification

Over 100 species and varieties of willow have been introduced into Australia. Canberra has been a major centre for these introductions and the City Parks Nursery holds 23 species.
New Zealand records show that over 50 species and varieties were exported to Australia during the period 1957-1990. Willows are notorious for hybridisation and this only adds to the number of different varieties as well as making a definite identification extremely difficult if not impossible.

The most widely planted and recognised willow in Australia is *Salix babylonica,* originally probably from a single female clone. Through hybridisation and possibly mutation there are now variations. Hybrids have been identified of *S. babylonica* with *S. alba* and *S. fragilis* (the next two most common species in Australia) and pollination of a greater number of *S. babylonica* flowers is only limited by differential flowering times.

Natural Regeneration

Determining the origin of a naturally regenerated individual is necessary if the source of the propagative material is to be eliminated. The first decision to be made is whether the plant is growing from seed or cutting. A young seedling has a single prominent taproot descending vertically, unless diverted by an obstruction. A plant with a horizontal "root" is probably growing from a detached buried twig or a buried layered branch attached to a nearby tree. In older plants the origin may be indicated by the uniform age of a group of trees or their position with respect to water height as seedlings often occur in "galleries" which have been deposited on a bank, either at the edge or within the main stream. Once the means of propagation is determined, the parent plant can then be sought, usually in close proximity of the offspring, and probably within 300 metres.

Conditions for seedling establishment are critical. Seeds survive only a few days without suitable germination conditions. Seeds which land on water tend to float on their "fluff" but soon the seed becomes detached and sinks. The seedling can continue to develop underwater for many days and the radical (root) does not emerge for some time (10-20 days) making it necessary for moist conditions to remain for weeks to ensure the seedling survives. Distant dispersal of plants by floods is therefore unlikely as high flood water will leave seedlings stranded on high and dry ground before they can establish.

Management Options

Once willow varieties have been identified (during September/November flowering period), and the source of propagation material found, it is important to plot all details on a map, marking the water course and position of willow trees, highlighting the trees posing the greatest problems. Considerations should include impact of willows on water flow, risk of unwanted propagules, effect if removed, replacement options and fencing necessary to protect replacement trees. A five year plan can now be drawn up. When planning for replacement vegetation, or new plantings to stabilise stream banks there are two important rules to follow:-
*Where possible use a native plant as an alternative to selecting willows.
*If willows seem to be the only suitable planting for the situation, beware of female willows unless willows of the species *Salix babylonica* are already present and clones of these are produced for further planting.

ENVIRONMENTAL LEGISLATION

Four pieces of legislation need to be considered in any plan.
The Native Vegetation Act 1997 continues to provide protection for certain land previously subject to the Soil Conservation Act. Removal of any vegetation (including willows) should be discussed with an appropriate officer of the Department of Soil and Water Conservation.

The Clean Waters Act 1970 regulates the use of herbicides on or near water. Consultation with the Environment Protection Authority will determine if a licence is required to carry out herbicide work. The Act may also require erection of warning signs and a report on the usage of herbicides and importantly urgent notification if any unforseen problems arise due to the herbicide or other willow removal activities.

The Pesticides Act 1978 requires the use of herbicides registered for the purpose for which they are being used. If the use does not appear on the label of the herbicide it either should not be used or alternatively a permit should be obtained from the National Registration Authority.

The Noxious Weeds Act 1993
In 1998 an order was signed by the Minister for Agriculture declaring all willows category W4g noxious weeds except *Salix babylonica, S.* x *reichardtii* and *S.* x *calodendron.* All other willows must not be sold propagated or knowingly distributed. In Maclean Shire only, the willow *S. nigra* is also listed in the W2 category. Following on from this declaration New South Wales Agriculture is now promoting the implementation of a willow strategy to encourage responsible management of these trees along water courses.

CONTROL

The aim of any control program should be to identify and selectively remove unwanted willows and their sources and to avoid the introduction of new willows of unknown compatibility.

Mechanical Control

Trees less than 0.5 metres tall can usually be pulled out by hand. The whole stem should be removed. Leaving smaller roots in the ground does not lead to suckering or regrowth (as often happens with poplar species).

Using large machinery, such as excavators or bulldozers, to remove larger trees and root systems is rarely justifiable and can cause extensive soil disturbance which is prone to erosion when water levels rise. In wet areas, bulldozers can incorporate a multitude of broken branches into the ground and thus generate numerous new plants. Any mechanical handling of trees, including felling for cut stump treatments, should be followed by a thorough clean-up of twigs and branches which have been dropped to avoid regeneration. Retrieving pieces from the water is obviously even more critical.

Chemical

Timing: Probably the best time to treat willows is December- March, especially for foliar spraying.
Herbicides: Only herbicides which are registered for controlling willow should be used. In most states the choice is limited to glyphosate. Roundup Biactive is registered for all *Salix* species for

foliar spray and stem injection. Registration for cut stump treatment is anticipated, however a permit should be obtained from the National Registration Authority at present to allow use of this method.

Foliar sprays are recommended on trees up to 2 metres high at the rate of 1-1.3 L/100L water.
Cut stumps should be treated within 30 seconds of cutting with concentrated glyphosate 360g/L as close to the ground as possible. Remember that small fragments of the branches may float downstream or push into moist soil on the bank and regenerate. It is therefore recommended to leave the tree where it lies and paint the cut trunk to quickly kill the top as well as the stump. Naturally it is important to remove the tree as soon as possible from areas where it is prone to movement by floodwater.

Stem injection is also carried out using concentrated glyphosate 360g/L and should be applied immediately the cut is made. Cuts or frills should be 2-3 cms deep, spaced about 13 cms apart around the trunk and receive 1-2 mls of undiluted glyphosate. In trees with multiple trunks or where sand and debris prevents applying herbicide to the lower main trunk, all accessible trunks should be treated as described.

Metsulfuron-methyl (Brush-Off) may be used under permit in the Upper Murrumbidgee Catchment only but permits for use of this herbicide in other areas can be requested from the National Registration Authority.

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PARTHENIUM CONTAINMENT WITHIN QUEENSLAND

Jim Willmott
Principal Land Protection Officer
Department of Natural Resources, Emerald

BACKGROUND

Where did it all begin?

First report of parthenium was in 1955 near Toogoolawah which is located in the Brisbane Valley. The actually mode of introduction is not accurately known but it is suggested introduction was due to the movement of aircraft and machinery parts into Australia during the Second World War

(Parsons and Cuthbertson 1992).

The second accidental introduction occurred in central Queensland, north of Clermont on a property called Elgin Downs in 1958. Contaminated pasture seed imported from Texas (USA) was blamed in this instance (Everist 1976).

The spread of Parthenium

In comparing the first two infestation sites within Queensland the spread of parthenium from the Toogoolawah site has not been dramatic in terms of area infested.
The Elgin Downs infestation left unnoticed until 1973 has spread throughout the central Queensland area. Favourable weather conditions and large scale land clearing assisted in the rapid spread to new areas from 1973 through to 1977 (Haseler and Butler 1984).

When did we realise the threat?

It was not until 1974 that parthenium was recognised as a serious pest to Queensland and by 1976 it was present in 14 shires and the negative impacts generated by this rapid unrelenting invasion from parthenium was becoming much more evident to the people of central Queensland.
Parthenium was first declared on the 11th of October 1975 under the Stock Routes and Rural Lands Protection Act of 1944 (Anon 1976).

Current Distribution

Most core infestations of parthenium are found in the sub-coastal regions of central Queensland, in areas with an average rainfall of 500-700mm (Haseler 1976). Numerous other core infestations have since established in the Queensland as far north as the Atherton Tablelands, south to the Lockyer Valley and west to the upper Bulloo River catchment area.
Isolated to scattered infestations exist in the eastern parts of central and southern Queensland and in the western and south west areas of the State.

PARTHENIUM CONTAINMENT PROGRAM

Declaration

The declaration of parthenium underpins the direction and coordination of containment activities. Parthenium is a declared plant under the provisions of the Rural Lands Protection Act 1985. Under declaration parthenium is placed in three different categories

Category P2 – where plants must be destroyed in that local government area

Category P3 – where infestations in the local government area are to be reduced

Category P4 – where plants are to be prevented from spreading beyond the places in which they occur.

Containment Activities

Roadside Spraying Program

The State Government provides herbicide to Local Governments that fall into P3 areas under legislation. The Local Government implements strategic roadside spraying of shire roads and a number of main roads to create a five to ten metre buffer zone along road verges and tourist stops. The objective of this program is to limit the spread of parthenium seed by movement vectors from P3 areas to P2 areas of the State through the creation of buffer zones adjoining major infestations.

Free Issue Herbicide

The State Government provides herbicide to effected landholders and local governments within all P2 areas of Queensland. This provides assistance to stakeholders in controlling isolated and scattered infestations outside of core areas.

Washdown Facilities

As with most weeds prevention is much easier and cheaper than cure. Parthenium seeds can spread by a host of different movement vectors. Vehicles and machinery passing through infested areas should be washed down to decrease the likely hood of spreading parthenium to new areas.

The State Government in partnership with other stakeholders promote the use and provide funding to assist in the establishment of Washdown Facilities at strategic locations throughout Queensland.

Extension and Awareness

The State Government in conjunction with stakeholders from local government, industry and community groups network and share resources to provide property manages in all areas with practical up to date advice on parthenium control and management.
This established network also produces a wide array of extension material and undertakes cooperative awareness activities that promote essential information such as identification and integrated control techniques.

Biological Control

State Government continues to fund research into biological control methods to fight parthenium in core infestation areas. Community groups such as the Parthenium Action Group and numerous other Landcare groups and landholders work closely with researches to assist in the establishment and distribution of biocontrol agents.

Regional and Local Pest Management Planning

Over the last three years the State Government has facilitated the development and implementation of Local Government Pest Management Plans within Queensland. Each Pest Management Plan is a pro-active step toward the management of pest species at a local level and ensures limited resources are used in the most effective way. Each plan is developed and it's implementation monitored by a working group made up of representatives from, State, local, community and industry.

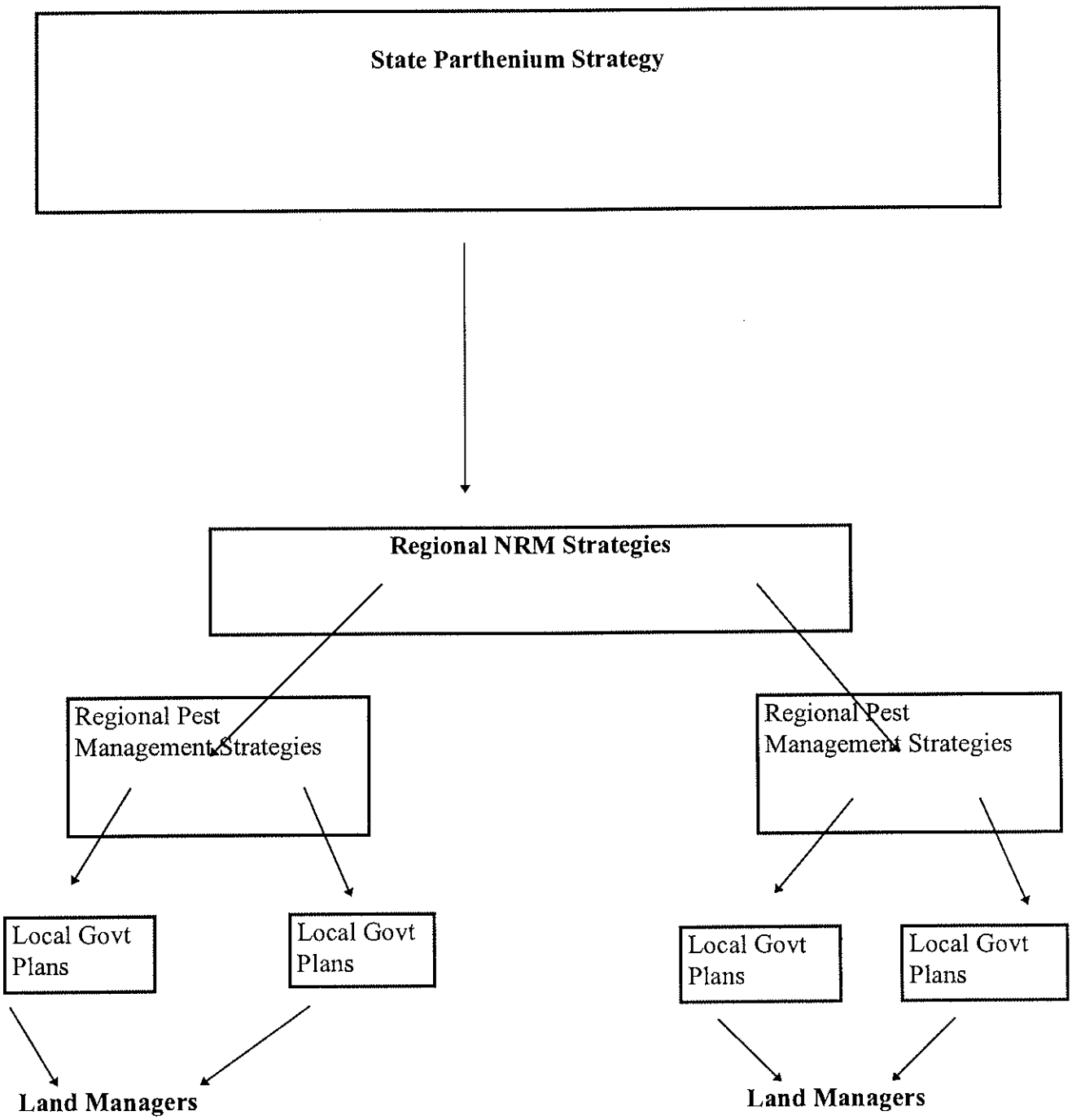
Most plans incorporate long term aims linked to actions for the control and continued management of parthenium. To increase the coordination and effectiveness of local pest management activities directed at parthenium and other pests, regional pest management groups are being established. These regional groups provide direction and ensure coordination between local government areas by taking a "whole of catchment focus".

Strategy Development for Parthenium

To increase the effectiveness of existing parthenium management activities and the development of initiatives to address new challenges with parthenium in Queensland the State Government has initiated the formulation of a Statewide strategy which will provide over arching direction and coordination to the ongoing management of parthenium.

The diagram below illustrates the future planning framework once completed:

PLANNING FRAMEWORK



TAKE HOME MESSAGES

1. Effective containment of parthenium requires communication, integration and commitment of stakeholders at all levels ie less finger pointing and more working together towards common goals.
2. Strategies must lead to positive on ground results to ensure adoption of effective containment measures by all stakeholders.
3. Industry and community stakeholders need to become more involved in planning processes developed for parthenium containment at a local through to a State level.
4. Containment of parthenium requires an integrated approach from a property level through to State focussed initiatives.

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GORSE IN THE BLUE MOUNTAINS

L. Auld, Degraded Lands Officer, BMCC
C. Banffy, Pest Management Officer, NPWS
F. Garofalo, Ecosystem Planner, BMCC
C. Ireland, Ranger, NPWS
E. Mahony, formerly BMCC; Bush Regeneration Officer, NPWS
M. Williams, Noxious and Environmental Weed Officer, BMCC

1. INTRODUCTION

Gorse *(Ulex europaeus)* is considered the most serious terrestrial weed in the upper Blue Mountains (M. Williams pers comm). This is due to: its largely unchecked expansion into remote and/or rugged areas since its introduction some thirty years ago; the local climate and altitude which are suitable to its growth; its prolific seed production and high numbers of viable seed stored in the soil; rapid maturation; difficulty and expense of effective control; its spread by machinery and along waterways.

Gorse can be classified as an "ecosystem transformer" and presents a serious threat to the area's high nature conservation values. Threats to conservation values include:

- the potential of gorse to colonise a large number of sub catchment areas in the upper mountains, and hence to spread some hundred kilometres downstream into very remote, rugged areas of the Grose, Jamison and Kanimbla valleys.
- gorse, left unchecked, forms impenetrable blocks, replacing native vegetation and negatively affecting visitor amenity, especially in Blue Mountains National Park. This replacement of natives as Gorse spreads is evidence of its capacity as an ecosystem transformer. Most of the creekline vegetation affected in the upper mountains is comprised of significant shrub and sedge swamp communities.
- numbers of rare plant species occur in areas infested by gorse at Blackheath (ie *Almaleea incurvata* along the Braeside creekline and *Isopogon fletcheri* in the general vicinity (Briggs and Leigh 1995). Frequent fire in the Blue Mountains could increase the possibility of Gorse seed germination in these sensitive areas.

2. GORSE

2.1 Description

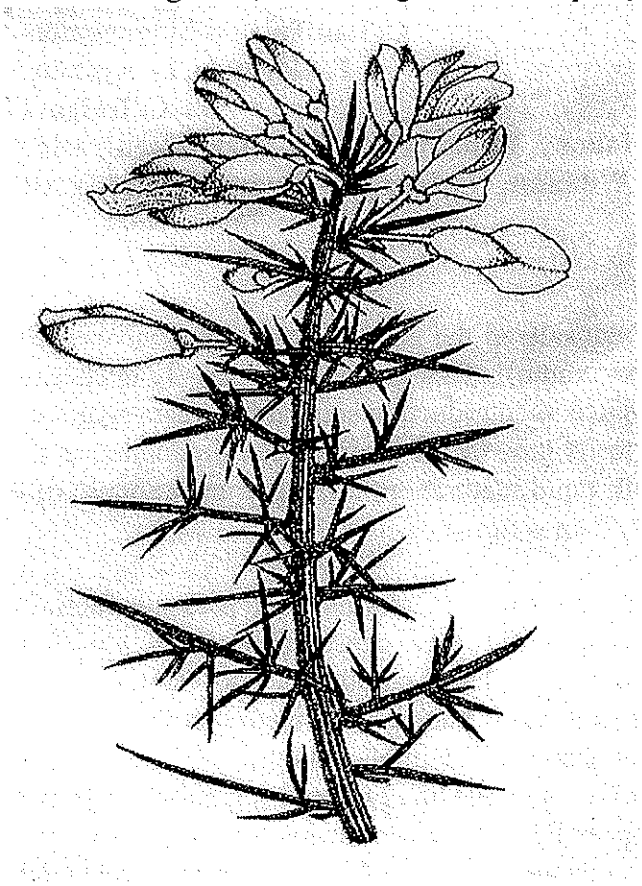
The genus *Ulex* is a member of the tribe Genisteae in the Fabaceae family. Gorse (*Ulex europaeus*), can grow to 4 metres with reproduction being by seed. Young growth is soft and green, with older growth is brown, and woody, armed with numerous spines to 5 cm long. Adventitious roots may be produced in procumbent plants.

Leaves are narrow and spine like, 1 to 3 cm long. Flowers are bright yellow and pea like, 2 to 2.5 cm long. Fruit is a dark ovoid pod, 1 to 2 cm long, densely hairy, with seed green to brown, about 3 mm long and triangular, smooth and shiny. Roots are mostly shallow, with some deeper but no well developed tap root (Auld and Medd 1987).

2.2 Life Cycle

Germination occurs best between 15 to 19C, with most germination occurring autumn and spring to mid summer. Seedlings are grazed upon, as they are not yet armed with spines,

and young plants are frost sensitive. Early seedling growth is rapid, with flowers first appearing from 18 months. Main flowering periods are July or August to October and from March to May. Plants are long lived, with new growth each spring (Auld and Medd 1987).



2.3 Origin and distribution

Gorse is a native of central and western Europe and the British Isles, where it forms an important part of native heathland vegetation.

Gorse is an important weed in Hawaii, New Zealand, Australia and parts of USA, Chile, India and also occurs in South Africa, Iran, Spain, Italy, Poland (Auld and Medd 1987).

Gorse occurs in all states of Australia apart from the Northern Territory. In Tasmania large areas of grazing land are infested, especially unimproved land. In the southern states, gorse mainly occurs on creek banks, roadsides, dumps, neglected land, and occasionally in pasture. Limited areas are found in Western Australia and Queensland (Auld and Medd 1987).

In NSW, gorse occurs on the North and Central coasts, Central tablelands and Central and South Western slopes (Auld and Medd 1987).

In the Blue Mountains area, dense occurrences have mostly been confined to the upper Mountains, with one known 20 year old stand of dense gorse in the Kings Tableland area, Wentworth Falls. New infestations are being found, mainly where soil has been imported.

The gorse occurs on both private and public land, with the private land most often forming part of the upper catchment of the public land. It would be difficult to put an accurate figure

on the break up of land tenure, but public land, while downstream of private land, would from about two thirds or more of the infested area. The area of dense infestation of Gorse in Blue Mountains National Park would be at least 30 hectares, spread along creeks.

2.4 Habitat

Gorse usually grows in temperate regions free of severe frosts, mainly on non-calcareous soils (Auld and Medd 1987).

2.5 Dispersal

Spread is by seeds, explosive ejection of seeds in the sun of up to 5 metres has been recorded in New Zealand. Birds and ants contribute to spread, as does gravel spread from infested areas (Auld and Medd 1987). Eroding sites which have Gorse seed present in the soil have led to the dispersal of seed down watercourses, with seedlings thriving in sediment deposits.. This has been the most significant cause of widespread dispersal of Gorse throughout natural systems in the Blue Mountains.

The huge seed bank in the soil is a long-term problem: There can be 17 000 seeds per square metre, (NZ DSIR 1986). NPWS experience in the Blue Mountains with germination post fire verify that this is not an overestimate (C. Ireland, NPWS, pers. comm.) Longevity of more than 20 years has been established (TAS DPI 1989). Even seed 25 years old is 85% viable (Auld & Medd 1987) with a soil seed store estimated as high as 100 million seeds per hectare. It is estimated that there may be a billion Gorse seeds in the Blue Mountains.

3. GORSE CONTROL

3.1 Gorse control in natural areas:

Much of the available research has been conducted in rural and forestry areas with little or none specifically in natural areas. Relevant work in natural areas has been carried out in the past five years first by the Popes Glen Landcare group, together with Blue Mountains City Council, and then from 1996 on in the Braeside area at Blackheath by NPWS using local and overseas volunteers.

A recent initiative is the State funded Urban Runoff Control Program which has funded contract bush regeneration works in Popes Glen. The work done by these groups has shown that the cut stump method of treatment with undiluted glyphosate, while painstaking, is certainly effective and virtually eliminates off-target damage.

3.2 Biological control

Bio control has been attempted with only moderate success (Auld & Medd 1987). Some five biological control agents have been introduced into Hawaii. The population increase and damage caused by *A. ulicetella* and the impact of *T. lintearious* in New Zealand and Oregon, USA led Hawaiian researchers to hope these agents will be highly damaging - in combination with winter damage through *S. staphylinus, P. genistella*, and the effects of *A. ulicetella*. Researchers are hopeful the rate of growth will be reduced and regeneration halted. The main emphasis of the program now in Hawaii is monitoring. (Markin, Yoshioka and Conant 1996).

It is unlikely that biocontrol agents would be effective in the upper mountains as the density and distribution of Gorse may not be sufficient to support effective population levels.

CSIRO staff involved in bio control work on Scotch Broom in the upper mountains have indicated that a combination of treatments would be most effective.

3.3 Physical removal and slashing:

Control is difficult due to the vigour and competitiveness of the Gorse (Auld & Medd 1987). Where possible **physical removal** with herbicide application (C. Banffy pers comm) has been found to be the most positive control method. **Slashing** is not effective due to strong stump regrowth.

3.4 Burning:

This is only effective in killing seeds if the fire is extremely hot (ie. 100 degrees Celsius for 5 minutes is needed to kill seed). Prior rolling/spraying can assist. The dense growth of seedlings which germinate after the burn must be controlled by cultivation, heavy grazing, spraying or hand removal. Early establishment of competition is very important. The burning can be used as a strategy to reduce flowering or to help exhaust the high seed soil supply.

3.5 Grazing by goats:

Goats can be most effective, especially in combination with prior burning and subsequent sheep grazing. The logistics of this method (eg. fencing kilometres of creeks in the National Park) make its use prohibitive in may natural areas of the upper Blue Mountains.

3.6 Herbicide spraying:

Spraying, especially in combination with burning and replanting, has been found to be effective in New Zealand. Aerial application is not as effective as spot spraying and moisture stress affects the control of Gorse plants negatively. The impact of off target damage needs to be considered in the natural areas of the Blue Mountains which are currently infested and/or are prone to attack..

3.7 Competitive cover

Seedlings are very susceptible to competition and dense vigorous competitive cover needs to be established as soon as possible to assist control. The efficacy of this approach in controlling seedlings has been observed in the Blackheath area (C. Ireland pers comm).

4. LEGISLATIVE REQUIREMENTS

4.1 Responsibilities of landholders and authorities

All landholders and public authorities have a responsibility to control noxious weeds as required under the category specified by the Noxious Weed Act 1993, ie. continuous suppression and destruction (W2) for Gorse in the Blue Mountains area.

4.2 Co-operative management

Since 1991 government agencies in the Blue Mountains have sought to co-operatively manage noxious weeds including Gorse, via the local Noxious Weed Co-ordinating Committee, set up by the Blue Mountains City Council (BMCC) with NPWS providing a secretarial role. Membership of this group now includes representatives from Blue Mountains Bushcare Network (ie Landcare and community Bushcare groups), BMCC, NPWS, Sydney Water, Integral Energy, SRA, RTA, and the Nursery Industry Association.

5. GORSE IN THE UPPER BLUE MOUNTAINS

5.1 Origins

The origin of the Gorse is not confirmed. In Europe it is often used for windbreaks and hedges. This may have been its use in Blackheath. Local oral history indicates that Gorse was present at three locations at least 25 years ago: "Parklands" in the Popes Glen catchment, a horse paddock and the Blackheath Golf Course, both upstream of Braeside (ie. Govett's Brook catchment).

5.2 History of spread

By 1990 both tributaries of the Grose River that surround Govetts Leap at Blackheath ie Braeside and Popes Glen featured dense stands of 3-4 metre high Gorse, forming 100% cover along hundreds of metres of the creeks lessening in density as the cliffline approached.

Downstream in the Grose Valley, in 1991 the local Ranger had found scattered mature plants along Govett's Creek. Two years later, the NPWS naturalist observed thousands of Gorse and Scotch Broom (*Cytisus scoparius)* seedlings at the junction of the Grose with Govett's Creek. Around this time too, Sydney bush regenerators reported that mature Gorse plants existed at the far downstream end of the Grose River, more than fifty kilometres from Blackheath, at Navua Reserve.

Some of the more recent localised infestations seem clearly related to the importation of Gorse seed in soil or perhaps via machinery (E. Mahony pers. comm.).

5.3 Major infestations

As mentioned previously, three major areas of Gorse infestation have been located:

- Braeside area, Blackheath (ie. Govett's Brook sub catchment).
- Pope's Glen Creek subcatchment; Blackheath.
- upstream of Bedford Creek, Kings Tableland, Wentworth Falls

There are also less serious infestations at over ten upper catchment locations in Blackheath, Medlow Bath with both the Grose and Coxs catchments being affected. There are at least three infestations further east, in the Katoomba-Leura area, affecting the Grose and Jamison catchments.

5.4 Gorse Infestation in the Upper Blue Mountains: Causal Factors.

Ridgetop urban development and the lengthy urban to bushland interface places the conservation of the National Park and other natural areas downstream under considerable threat of Gorse infestation.

The main causes of Gorse infestation and spread are listed below:-

- **Initial "infective agents" eg. deliberate introduction (eg. use as a hedge plant) or accidental introduction (eg. fill).** Deliberate introduction will not be considered here as it is extremely unlikely that this practice is continuing. The main source of accidental introduction would be imported in fill. This has the potential to spread Gorse seed across the upper Blue Mountains in fill or on earthmoving equipment.

- **Urban runoff**: this leads to silt build up and deposition of weed seeds and propagules onto creek and river flats, with potential nutrient enrichment of these areas further encouraging germination and growth.

- **Spread from adjoining properties:** this, although an important factor in the spread of Gorse via the plant's "explosive" seed dispersal mechanism, is relatively slow. It is when this is combined with water based soil erosion that rate of spread is greatly increased.

- **Disturbances:** (eg. sewer installations, powerlines etc): such disturbances provide both conditions conducive to Gorse germination as well as potentially erosive "corridors" for seed dispersal to surrounding drainage lines and creeks.
- **Slashing while in seed:** this presents two problems; firstly it extends the spread of the plant on site and secondly allows for its movement off site via machinery. Slashing for access should only be carried out prior to seed set.

5.5 Management Action to Date

As stated previously, since 1991 cooperative work on Gorse control by the relevant agencies has been carried out, coordinated by the Blue Mountains Noxious Weed Coordinating Committee.

Main techniques used have been high volume spraying, with some slashing and one burn at Blackheath Golf Course, with cutting and painting with herbicide and spot spraying more recently.

5.6 Results of Management Actions

5.6.1 Case by case assessment and review

In summary, case by case assessment is needed to determine best techniques and level of expertise needed for each Gorse infestation. Regular review is also crucial - as the response of treated areas needs to be closely monitored to achieve the best outcomes.

5.6.2 Co-operative management

Cooperation is the crucial factor - as so many changes in land tenure occur in the catchment areas. Maintaining adequate funding and support for BMCC in its role as inspector of noxious weeds on private land is absolutely essential. this program is the cornerstone of the whole program, as the upper catchment sources of infestation occur on private land.

5.6.3 Efficiency and effectiveness

Improvements in efficiency and effectiveness have been made by the BMCC Noxious Weed section through the employment of full time bush regenerators and upgrades in equipment.

Improved herbicides have contributed to the successful treatment of Gorse. The problem of off target damage remains especially when dealing with extremely sensitive ferns in natural areas, with the ferns providing much needed "competitive cover".

The use of bush regeneration techniques and cutting and painting with Roundup Biactive near sensitive creek environments has proved most effective in natural areas, with little or no off target damage and accelerated revegetation compared to sprayed area (C. Banffy, NPWS Pest Officer).

5.6.4 Integrated programming

Increased flexibility and integration in the use and selection of different techniques ie combining high volume spraying with cut and paint, spot spraying and revegetation (the last as a means of helping suppress gorse regrowth) has been most effective. Joint monitoring is most useful for pre planning.

5.6.5 Community awareness

Progress is being made towards enhanced public awareness of the threat that Gorse poses through educational displays and activities, ie Weeds Awareness Week, World Environment Day, and the planned Gorse Education officer to liaise with contractors and agency staff etc.

5.6.6 Co-ordinated mapping and treatment programs

Increased levels of information through co-ordinated mapping and treatment programs across agencies are starting to be available through the Blue Mountains Weed Mapping System.

5.6.7 Community participation

Community participation was found to be invaluable in the past six years with the twice annual Great Grose Gorse Walk, which initially focussed on mapping and treating infestations in remote areas. In these situations control would be difficult if not impossible if infestations were allowed to develop in size and establish a seed soil bank.

As the most remote areas were treated, focus came to rest also on the catchment area, with ongoing cooperative work between local Bushcare groups and BMCC Bushcare staff, who donated their expertise, Friends of Blue Gum Forest and community members providing the labour. NPWS, having initiated the idea, provided administration and coordination..

This is an ongoing project, as a "watching brief" needs to be kept on remote seed soil stores, and as each year new infestation are found along tributaries. The Walk has grown to the size where professional regenerators are contracted to supervise the volunteers, who mainly are interested individuals, bushwalkers, TAFE students, or members of groups like the Sporting Shooters.

The funds provided to Popes Glen upper catchment area, plus direct funding for the Gorse Walk and for followup in Braeside and remote work in the Grose from the Urban Runoff Control Program have been invaluable.

6. GORSE MANAGEMENT - AIM, OBJECTIVES, STRATEGIES

The aim and objectives have been clearly identified in the local Gorse weed control plan, as outlined below.

6.1 Aim:

To protect and enhance the Blue Mountains ecosystem for its intrinsic worth and for the economic benefits the natural environment provides the local, regional and national economy, through the management of Gorse.

6.2 Objectives:

6.2.1 Annual monitoring of known infestations on private land to be completed each February. A follow up inspection to be arranged : necessary spraying in April

6.2.2 Twice annual monitoring and retreatment of known infestations on BMCC land; NPWS and Sydney Water monitoring and retreatment

6.2.3 Annual monitoring and control: ongoing investigation of reported new infestations on BMCC land; regular mapping and treatment of remote infestations on NPWS each 18 month period

6.2.4 Site management plans developed for each new infestation within 3 months of discovery

6.2.5 prevention of new infestations through: the development of education processes targeting contractors, agency staff and landholders; removal of mature specimens pre seed release; control of soil borne propagules

6.2.6 reduction of existing infestations through removal of mature specimens pre seed release

6.2.7 formal processes: mapping of known infestations and non infested target areas for Gorse

6.2.8 annual evaluation and refinement of Gorse local weeds action plan by local weeds committee

6.2.9 investigation of secondary control measures appropriate for native ecosystems

6.2.10 development of community participation in Gorse mapping and control; establishment of a long term monitoring program using quadrats

7.0 BARRIERS TO OVERCOME:

Resourcing is always a concern, especially for research and for establishment of full-time bush regeneration actions including in difficult and remote terrain.

The **lack of legislation that covers seed contaminated soil** providing no controls for soil borne propagule transport is a major issue to address in terms of prevention. .

Greater inter and intra agency co-ordination and planning, monitoring and review is necessary, as are site management protocols.

Timeline constraints in terms of due to enforcement protocols on private land must be taken into account, as must the **diverse target audience** of any education in the Blue Mountains area.

Insufficient data is available on seed bank dynamics of Gorse and **research is needed into the effectiveness of different techniques** in terms of off target impacts.

TAKE HOME MESSAGES:

- **Look beyond the obvious to causes of spread (eg infected soil): this enhances prevention...**
- **Integrated management and use of techniques are essential as weeds know no boundaries**
- **Volunteers need resources and also act as a magnet for outside funding**
- **It is crucial to monitor...monitor...monitor!**
- **Education is prevention in many cases**
- **Never say die! The worse a problem, the more eager recruits may be found who love a challenge**

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THE CAMPHOR LAUREL PHENOMENON

A Magnificent Dilemma

Bruce Scott
General Manager/Chief Weeds Officer
Far North Coast County Council

OVERVIEW

Camphor Laurel is one of the most beautiful exotic trees to found on the coast from Sydney to Gympie. It is an excellent shade tree for stock and provides an abundance of berries for many native bird species, particularly for pigeons. Since the 1920's it has been the shade tree of choice in most school yards.

At the time of Closer Settlement landholders were required to clear fell their properties. In the 1930's the Department of Agriculture promoted tree plantings to provide shade for the dairy cattle exposed to the elements on the treeless pastures. Camphor Laurel was one of the trees promoted.

Early Camphor Laurel came from China and produced mainly single stemmed large diameter, long trunked trees. In latter days trees were also imported from Japan and Taiwan. There is a theory that crosses between the different gene pools has resulted in multi-stemmed trees producing huge quantities of viable seed. The multi-stemming means the timber is of limited value to the woodworking trade. It is difficult to obtain reasonable lengths (>2.5 metres) of straight timber with a diameter of at least 300 mm at the small end.

Exports of Camphor Laurel logs almost ceased due to unscrupulous vendors supplying timber that did not come up to specification. We were seen to be unreliable suppliers.

Most of the Camphor oil (possibly as high as 95%) used today is synthetic. There is a niche market for natural Camphor oil, which is developing. The small premium being paid for natural oil makes production barely viable.

CAMPHOR LAUREL THE VALUABLE TREE

There are many uses for Camphor Laurel and its products.

Wood-turning: Camphor Laurel timber is sought by wood-turners for a range of products for the local and export trade. Trees from Asia tend to have very pale timber. Australian timbers tend to have stronger grain patterns. Trees from southern slopes and areas where growth is slower tend to produce the more valuable darker timber.

Furniture manufacture: There is a growing demand for Camphor Laurel timber furniture. There is a great potential to export, particularly in flat packs to the USA.

Export logs: As mentioned above there is demand for logs, but as most Camphor Laurel available can only produce short lengths the market may be limited. The potential appears to be in exporting slabs as much more can be packed into a container in that form.

Oils: Synthetic Camphor Laurel oil can be produced very cheaply. There is a niche market for genuine Camphor oil, but the premium is not high. Extra refining of the oils to remove undesirable chemicals could improve returns, but also increases costs.

Mulch: Many Councils utilise the tree as garden mulch. It is generally suggested that the mulch should stand for some time before use to allow the oils to leach and/or evaporate. Claims have been made for the insect controlling properties of Camphor mulch.

Paper: Camphor Laurel timber makes excellent paper, but the extraction rate is too low. This means the cost of the finished paper is not competitive.

The value adding project being administered by the Northern Rivers Regional Organisation of Councils has some exciting prospects for large scale use of Camphor Laurel timber and bi-products. It is anticipated that I will be in a position to give more detail at the Conference

CAMPHOR THE PROBLEM TREE

In some areas of the North Coast, Camphor Laurel makes up over 80% of the tree canopy. Camphor Laurel is not invasive to forests, but is invasive on open country.

The spread of Camphor Laurel has seen a massive increase in bird numbers resulting in increasing quantities of seed being spread. Birds are the major spreading mechanism. Birds tend to roost near steam and on fences. For this reason fenced roadsides, and stream banks are being taken over by Camphor Laurel, to the point of monoculture in many situations.

In some areas of the Orara Valley (west of Coffs Harbour) and on the Far North Coast, Camphor Laurel grows in broad leaf and narrow leaf Privet associations. Removal of one species will lead to the spread of the other.

Camphor Laurel is spreading rapidly along the Coast north of Sydney. Stop! Have a look at the Camphor Laurel in your area. On average around 30% of Camphor Laurel trees would be less than 3 metres high. In parts of the Orara and Tweed Valleys the figure is closer to 50%. That means that around 30% of trees are less than three years old. That is a frightening thought. This expediential rate of spread must be checked.

Bruce Hungerford(1) stated at a Brunswick Catchment Management field day at Mullumbimby on 1/5/99, "To be successful with the removal of Camphor Laurel we must remove it faster than it is spreading. To achieve that rate of control we must use herbicides. We could not achieve the required results by non chemical means".

REASONS FOR SPREAD

There are a number of theories for this.

Seasonal Conditions: Some environmentalists suggest that it is because of the seasonal conditions over recent years. I do not subscribe to this theory.

Older seed bearing trees: There appears to be evidence to support the theory that older trees, particularly trees over thirty years old, produce larger quantities of viable seed. Maybe, they also become permanent homes for birds. There are a number of cases in areas where Camphor Laurel is not normally a problem where, all of a sudden, thirty odd years after they were planted, massive

numbers of seedling Camphor Laurel are appearing. Some people support the theory that the older trees have crossed with trees from other genetic pools resulting in trees with large seed crops.

Increase in bird numbers: Most experts can provide data to show that the increase in Camphor Laurel spread is directly related to increased number of bird species and total number of birds feeding on Camphor Laurel.

Reduced cattle numbers: More and more of the coastal strip is moving away from livestock. Much of the change is to rural residential holdings, both large and small. The result is a revegetation of the country with native and exotic plants. Many of the woody weeds, (Lantana, Cockspur thorn, Wait-a-while, Privet, etc) are used by birds for roosting. Cattle tend to eat seedling Camphor Laurel. The combination of fewer cattle and more woody plants results in more seedlings establishing in old pasture lands.

Financial constraints: In many cases, landholders, particularly graziers, controlled seedlings as they appeared. Most graziers and other landholders no longer employ people to work their land, so time limits their ability to address the Camphor Laurel problem. Low cattle and other commodity prices mean there is not the disposable funds to expend on weed control.

Environmentally conscious community: More rural based people are aware of the degradation of our environment. There are thousands of people planting trees as they see the need to address the problems caused by the vast clearing that took place in the past. As one fellow said to me "a tree is a tree is a tree. You will never get me to remove any trees, not even Camphor Laurel, from my property."

THIS SINISTER TREE

Camphor Laurel is coming under close scrutiny and for good reason. A lot of fingers are being pointed at Camphor Laurel.

Allelopathy: For a long time it has been conjectured that Camphor Laurel has properties that inhibit the growth of other plants in close proximity to it. I have seen little evidence that it is caused by chemicals. The tree has a massive very shallow root system. Many plant species, including Camphor Laurel, will germinate and develop into stunted seedlings. Once the Camphor Laurel is killed the seedlings will flourish. This indicates competition for light, moisture and nutrients rather than allelopathy.

Stream ecosystem damage: ***Trials in the Orara River, by Dr R A Bishop (3), have shown that crushed and uncrushed leaves in the River caused the death of fingerlings in a controlled experiment. Exudates from Camphor Laurel have been linked to the death of tadpoles (J Friend (4))in streams lined with Camphor Laurel near Lismore. A research study is being undertaken by Patrick Pahlow(5) to assess the effects of Camphor Laurel on invertebrates in streams on the North Coast. The hypothesis is that Camphor Laurel causes a decline in the invertebrate population in stream. As these invertebrates are towards the bottom of the food chain, the effects higher in the chain could be significant if the evidence shows such a decline. Camphor Laurel forms monocultures on streambanks and in other areas. It causes total shading of the stream.***

Streambank destabilisation: In a personal communication, Geoff Sainty(2), an Australian water weed expert, likened Camphor Laurel to Willows on stream banks. Its shallow root system provides no protection to the stream bed. As nothing much grows amongst the root area, the stream banks are

more susceptible to erosion than banks lined with native stream bank species. Trees are easily undermined by increased stream flows resulting in trees toppling into the stream.

Soil erosion: Camphor Laurel trees on steep slopes are often associated with the development of gully erosion due to the bare earth amongst their root system. Some people try to say that the shallow roots hold the soil together. On slight slopes any roots are advantageous. On steeper slopes though, they can be disastrous.

Carcinogenicity: Research in the US has shown that a number of the chemicals in Camphor Laurel are carcinogenic. Indications from samples tested from trees in the Lismore area in 1999 show high. J Friend(4) has references to this work.

Declaration: The North Coast Weed Advisory Committee has recommended to all Councils from Taree to the Queensland border to consider requesting the declaration of Camphor Laurel. So far only Far North Coast County Council and Maclean Council have requested declaration. Ulmarra is preparing a submission. In the case of Far North Coast County Council the request applies to the County district excluding the Tweed, Byron and part of the Ballina Shire, as the tree is past the point where declaration could be enforced in those three areas.

The proposed declaration would be category W4(?) and the control requirements requested are:
(a) All trees of a height of less than three (3) metres be fully and continuously suppressed and destroyed;

(b) All trees of a height of three (3) metres or taller be fully and continuously suppressed and destroyed;

(c) Occupiers of land may submit management plans for exemption from part (b) provided the plan requires the gradual removal of all Camphor Laurel trees from the property over a period of up to twenty (20) years and provided that;

(i) the management plan is to the satisfaction of the Local Control Authority;
(ii) the management plan is strictly adhered to; and
(iii) the management plan contains an acceptable tree replacement strategy

(d) Trees of heritage significance may be excluded from part (b)."

RWAP Project: ***The North Coast Weed Advisory Committee has been granted funding under the Regional Weed Action Program to employ a Project Officer to oversee the project. Fifty percent of the project is devoted to Camphor Laurel, 40% to Bitou Bush and 10% to other environmental weeds.***

The main emphases of the Camphor Laurel component are:
1. To determine what research is required into problems and benefits of Camphor Laurel. Once defined the Project Officer will attempt to find funding and institutions to undertake the work.

2. To develop a control kit that will contain chemical and non-chemical control techniques, lists of replacement trees, cross reference tables to assist landholders to determine what legislation may affect their control programs. Things like Council Local Environment Plans, Trees located on prescribed streams, trees on slopes over 18 degrees etc.

3. Develop a tree replacement strategy and organise the propagation and distribution of trees.

4. Value Adding. The project will coordinate efforts by other groups who have developed reports on value adding to Camphor Laurel products as a means of offsetting control costs.

The Project Officer should have been appointed by the end of May 1999. A progress report to date will be given at the Conference

CAMPHOR LAUREL CONTROL

A number of control techniques will be demonstrated during the field excursions. These will include stem injection using axes, spears and chainsaws, cut stump and cover spray techniques. Bruce Hungerford(1) has produced a good guide to control techniques.

TAKE HOME MESSAGE

Now is the time to consider the declaration, or coordinated control of Camphor Laurel. Tomorrow may be too late, as it is in some parts of the North Coast and Far North Coast.

Make a point of seeing how many young Camphor Laurel are growing in your area. Don't let them take over your landscape.

Camphor Laurel is a magnificent looking tree, but looks can be deceiving.

Small Camphor Laurel trees that are cheap and easy to control, quickly turn to large trees that are difficult and expensive to deal with. Get them while they are small.

This paper asks more questions than it answers. If you have a view on Camphor Laurel, particularly if it is backed by hard evidence, please contact the Project Officer. This may be done through the Far North Coast County Council.

ACKNOWLEDGMENTS

(1) Bruce Hungerford, Catchment Manager, Department of Land & Water Conservation , Murwillumbah, NSW

(2) Geoff Sainty, Consultant, Sainty and Associates, Potts Point NSW

(3) Extract from: Coffs Harbour Water Supply Augmentation EIS, Aquatic Studies – Freshwater Fish, Dr R A Bishop, Freshwater Biology Consultant, BUNGWAHL, NSW

(4) Camphor Laurel Toxic To Certain Australian Wildlife And A Threat To Species Biodiversity In Coastal NSW, Joe Friend, The Channon via Lismore.

(5) Patrick Pahlow – Estuarine Ecologist, Department of Land & Water Conservation, Murwillumbah NSW.

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SERRATED TUSSOCK (NASSELLA TRICHOTOMA) CONTROL USING GLYPHOSATE IN SOUTHERN TABLELANDS OF NSW

B.Verbeek[1], B.R. Milne[2], L. Ayres[3], F.J. Leech[4], J. Booth[5] & R. Gorman[4]
NSW Agriculture
[1] Wagga Wagga Agricultural Institute, Private Bag, Wagga Wagga. 2650
[2] Orange Agricultural Institute, Forest Road, Orange. 2800
[3] PO Box 798, Cooma. 2630
[4] PO Box 20, Yass. 2582
[5] PO Box 408, Queanbeyan. 2620

INTRODUCTION

Serrated tussock, a native of South America, is a serious perennial grass weed of pastures and native ecosystems in the tablelands districts of NSW, Victoria and Tasmania. In grazing systems it has the potential to severely restrict or eliminate grazing productivity. Management of this weed has become more difficult with the removal of Frenock® from the market, which was the most effective herbicide available to control it.

Over the last 15 years a number of herbicides apart from Frenock® have been tested for their efficacy on serrated tussock. Of these glyphosate appears to be the most effective herbicide. Early work using glyphosate to control serrated tussock identified that results were often erratic and sometimes required very high rates of up to 11 L ha^{-1} to achieve a moderate kill of 77% (Campbell and Gilmore 1979).

Trials conducted in Victoria (Miller 1998) have revealed promising results with rates of between 3 and 5 L ha^{-1} (45% ai) on serrated tussock burnt 12 months prior, to spraying. However, these rates were not as effective on large mature serrated tussock plants which were not burnt previously. Differences in efficacy of glyphosate on serrated tussock between NSW and Victorian populations has led to the belief that there may be different cultivars present in Victoria and NSW.

In response to the need to gather data on the efficacy of alternative herbicides on serrated tussock a series of experiments were conducted over a number of sites on the southern tablelands of NSW.

METHODS

Herbicides were applied at Michelago and Bredbo with a 2m hand held boom fitted with Lurmark LP01F80 nozzle tips delivering 108 L/ha at 200 kPa. At Yass a 3m hand held boom fitted with TeeJet 8001LP nozzle tips delivering 100L/ha at 240 kPa was used. This spraying equipment is equivalent to that which would be used on farm for broadacre herbicide application. Plots were 10 metres long, arranged in randomised complete blocks of 3 replicates.

Efficacy of herbicides was visually assessed four months after spraying (Table 1 and 2). The data are the mean of three replications at each site. All sites will continue to be monitored for regrowth of serrated tussock for at least twelve months after spraying.

At Michelago serrated tussock was sprayed just prior to head emergence conditions for spraying were excellent, both weed and pasture species were actively growing, the soil was moist. Weather conditions were overcast in the morning, clearing as the day went on, with temperature of 15° C and

a slight breeze. Burnt plots at Michelago had regrown to a certain degree at the time of spraying but plants had a fairly small proportion of green leaf compared to the amount of green leaf present in unburnt serrated tussock at the same site (Table 3). At Bredbo the soil was dry and pasture species were showing some level of moisture stress although this was not evident in the serrated tussock. Weather conditions for spraying were excellent, a fine day of 22°C with a slight breeze. At Yass the serrated tussock seed heads were just emerging, the soil was dry, but pasture and weeds were not showing any signs of stress. Spraying conditions were ideal, overcast in the morning clearing as the day progressed, temperature of 18°C and a slight breeze.

Serrated tussock density and percentage green leaf was measured at each site (Table 3). Density was measured at Michelago and Bredbo by visually estimating (frequency %) percentage ground covered by serrated tussock bases in 2 by $1m^2$ quadrates/plot. At Yass plant counts were taken in 4 by $0.25m^2$ quadrates/plot. Percent green leaf was measured by harvesting a number of representative plants at each site and separating dead from green leaf material. The majority of plants at each site were big old plants.

Experiment 1

The effect of different glyphosate rates and formulations on serrated tussock.

Five rates of Roundup Biactive® (4,6,8,10 and 15Lha $^{-1}$) with equivalent rates of Roundup CT Extra® and Touchdown Broadacre Herbicide® were applied at three sites, Yass (9/11/98), Michelago (22/10/98) and Bredbo (2/11/98). At Michelago these herbicides were also applied on serrated tussock that had been burnt approximately 8 weeks prior to spraying on the 22/10/98

Experiment 2

The effect of different spray adjuvants mixed with Roundup CT Extra® on serrated tussock

Four rates of Roundup CT Extra® (2,3,4 and 5L ha^{-1}) with the addition of Wetter TX®, SprayPlus®, and Hasten® were applied at the same sites and on the same day as described above.

Table 1: Percent control of serrated tussock four months after spraying using different glyphosate rates and formulations

Prodnct	Rate L/ha	Yass	Michelago Burnt	Michelago Unburnt	Bredbo
Roundup Biactive ®	4	100	99.6	97.7	97.9
Roundup Biactive ®	6	100	99.3	99.5	98.2
Roundup Biactive ®	8	100	99.7	100	100
Roundup Biactive ®	10	100	99.6	99.4	100
Roundup Biactive ®	15	100	100	99.8	100
Roundup CT Extra®	2.9	100	98.5	98.8	100
Roundup CT Extra®	4.4	100	100	100	100
Roundup CT Extra®	5.8	100	98.7	100	100
Roundup CT Extra®	7.3	100	100	99.8	100
Roundup CT Extra®	11	100	99.7	99.8	100
Touchdown Broadacre Herbicide®	3.48	100	99.4	99.3	100
Touchdown Broadacre Herbicide®	5.22	100	99	99.8	100
Touchdown Broadacre Herbicide®	6.96	100	100	99.8	100
Touchdown Broadacre Herbicide®	8.7	100	100	100	100
Touchdown Broadacre Herbicide®	13.5	100	99.5	100	100

Table 2. Percent control of serrated tussock four months after spraying due to different rates of Roundup CT Extra® and spray adjuvants.

Product	Rate L/ha	Spray Adjuvant	Yass	Michelago Burnt	Michelago Unburnt	Bredbo
Roundup CT Extra ®	2	Wetter TX 0.2%	100	98.3	100	100
Roundup CT Extra ®	3	Wetter TX 0.2%	100	97.2	100	100
Roundup CT Extra ®	4	Wetter TX 0.2%	100	99.7	100	100
Roundup CT Extra ®	5	Wetter TX 0.2%	100	99.5	100	100
Roundup CT Extra ®	2	Hasten 1%	100	97.1	100	100
Roundup CT Extra ®	3	Hasten 1%	100	99.4	100	100
Roundup CT Extra ®	4	Hasten 1%	100	99.3	100	100
Roundup CT Extra ®	5	Hasten 1%	100	98.4	100	100
Roundup CT Extra ®	2	SprayPlus 1%	100	100	100	100
Roundup CT Extra ®	3	SprayPlus 1%	100	100	100	100
Roundup CT Extra ®	4	SprayPlus 1%	100	99.2	100	100
Roundup CT Extra ®	5	SprayPlus 1%	100	100	100	100

Table 3: Serrated tussock measurements

Site	% green leaf	Range dry weight (g) of green leaf	Range Frequency %
Yass	35 - 81	-	12 (plants m^{-1})
Bredbo	74	150	31.8 - 40.5
Michelago Burnt	100	1.7 - 6.97	51.3
Michelago	16 - 54	15.71 - 79.19	22.8 - 44.5

RESULTS

All glyphosate rates and formulations gave excellent control of serrated tussock at all sites. However, irrespective of rate, an occasional serrated tussock plant was found to be regrowing or not affected. These were always smaller plants or seedlings that were well sheltered from the herbicide by foliage of large plants.

Little variation in efficacy of Roundup CT Extra® due to different spray adjuvants was observed as excellent control of serrated tussock over all rates was obtained.

The relatively small amount of green leaf on the burnt serrated tussock at Michelago compared to the amount of green leaf in mature tussock (Table 3) did not appear to inhibit the efficacy of the glyphosate. Good rainfall (250mm) was recorded at Michelago between spraying and February 1999 when the last assessment was taken, serrated tussock plants in the control plots of the burnt trial had grown.

Although glyphosate has given excellent control of serrated tussock in these trials at different sites it is still too early to give a final conclusions as a longer period of time must elapse before final assessments are made.

TAKE HOME MESSAGES

- Glyphosate may be effective at killing serrated tussock at rates much lower than are presently recommended for use on Permit 2036 (6 - 15L ha^{-1} of 36%ai).

- Glyphosate is a non-selective herbicide and its use to control serrated tussock when compared to Frenock® will have a number of disadvantages, the greatest being its lack of selectivity and effect on non-target species. Glyphosate should be used as a tool in an integrated plan of control which should include the determination of optimum spraying time in relation to other vegetation present and/or sowing competitive crops and pasture species.

- Glyphosate is most effective when used on plants which are actively growing and should only be used when conditions are conducive to spraying.

- In order to get good coverage of serrated tussock plants with herbicide it is very important to use spray equipment which is well maintained and calibrated prior to use. Use spray nozzles and pressures which will give a spectrum of small droplets which when applied will swirl into and around serrated tussock plants to achieve a good even coverage of the plant.

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AQUATIC WEED MANAGEMENT IN USA

David Karlson
Operations Manager
Hawkesbury River County Council

INTRODUCTION

Hawkesbury River County Council was formed 50years ago to control water hyacinth in the Hawkesbury/Nepean River. Due to the western expansion of Sydney more pressure has been exerted on an already fragile ecosystem. In 1993 a massive outbreak of water hyacinth in the river required 2,500Litres of Reglone® and 18months of work to bring the infestation to a management level. 1994 saw the introduction of alligator weed in the same area and is now under constant monitoring and treatment.

The added pressure that these control programs are having on the river system has created concern as to the sustainability of these conventional control techniques. As a result, Council decided to investigate alternative control methods in an attempt to reduce the amounts of herbicide being used on the river.

In July 1998 the opportunity arose for me to attend the 38th Annual Meeting of the Aquatic Plant Society held at the Crowne Plaza Hotel, Memphis, Tennessee.

The following is an itinerary of the trip and some relevant information that may be of interest to Weeds Officers in N.S.W.

Itinerary

Wednesday 8 July	Departed Sydney for Los Angles
	3 days to relax and see the sights.
Saturday 11 July	Los Angles to Memphis
Sunday 12 July	Conference Registration
Monday 13 July	Conference commenced
Wednesday 15 July	Conference concluded.
Thursday 16 July	Memphis to New Orleans

Friday 17 July Tour of Louisiana Swamp to inspect alligator weed and water hyacinth control programs

Saturday 18 July	New Orleans to Orlando
Sunday 19 July	Orlando to St Augustine
Monday 20 July	St Augustine to Hollywood Beach
Tuesday 21 July	Hollywood Beach
Wednesday 22 July	Hollywood Beach to Key West
Thursday 23 July	Key West

Friday 24 July Key West to Fort Myers

Saturday 25 July	Fort Myers to St Petersburg
Sunday 26 July	St Petersburg to Orlando
3 days in Orlando	
Wednesday 29 July	Orlando to Gatwick

Monday 3 August	Pesticide Convention –Environment and Food, London
Tuesday 4 August	Convention
Wednesday 5 August	Convention
Thursday 6 August	Heathrow to Bangkok
	4 days in Bangkok
Tuesday 11 August	Bangkok to Sydney

Aim Of Trip

The aim of the trip was to investigate what success and or failures have been experienced in America using aquatic weed harvesters. I was amazed at the number and variety of harvesters being used in the States for aquatic weed control, and all of them being owned or operated by good salespersons who were all to eager to point out that theirs was the most modern and effective machine available. One gentleman from Texas, claimed that his 70feet long harvester was so manoeuvrable that he could "turn this thing on a dime and still give you nine cents change". Unfortunately many of the machines were based on blue prints drawn by the US Army Corp of Engineers back in the 1940's.

Of all the manufacturers I spoke to, only one, had the professionalism and proven machinery that I was interested in, Aquarius Systems from Wisconsin. They have been operating since 1964 and supplies harvesters and other weed control machinery to over 35 countries.

Aquatic Plant Management Society Conference

Following is a list of papers presented at the conference, if any of these are relevant to your situation I have an abstract of them and contact details of the author.

A Message to Our Public: Why Aquatic Herbicides Affect Aquatic Plants and Not Us.

ARS Weed Science: Strengthening Partnerships for the Next Century.

AERF Research and Education Update.

Renovate (Triclopyr) – A Potential New Herbicide for the Selective Control of Certain Aquatic Plants.

Review of Aquatic Environmental Fate of Triclopyr and Its Major Metabolites.

Endothall: New Formulations and New Uses.

Clearigate Research and Operational Experience.

2,4-D Registration and Label Update.

FasTEST Case Studies – What Are We Learning about Renovate and Sonar?

Selective Stem Treatments with Rodeo (glyphosate) for Control of Brazilian Peppertree.

An immunochemical Analytical Method for Endothall, the Active Ingredient in Aquathol K and Hydrothol 191 Aquatic Herbicides.

Aquatic Dissipation Modeling of Endothal.

Reward (diquat): It's Not the Same Old Diquat.

A Review of Fall Applications for Selective Control of Eurasian Watermilfoil.

Selective Management of Hydrilla Using Sonar.

The Bioalgicidal Potential of Fresh Cut Alfalfa and Reed Canary Grass on Seceral Algal Species.

Potential Use of Cattail *(Typha domingensis)* and Its Allelochemicals in the Biological Control of Salvinia *(Salvinia minima)*.

Growth of Bog Rush *(Juncus megacephalus)*.

Review of Results from Studies on *Euhrychiopsis lecontei* Undertaken in Vermont and Massachusetts 1989-1998.

The Weevil-Watermilfoil Interaction at Three Spatial Scales: What we Know and what we need to Know.

Implications of Life Cycle Timing in Acentria ephemerella and Eurhrychiopsis lecontei for the Biological Control of Eurasian Watermilfoil.

Euhrychiopsis lecontei, Distribution and Factors Influencing Its Abundance in Wisconsin Lakes with Emphasis on Its Use as a Biological Control for Eurasian Watermilfoil. *(Myriophyllum spicatum)*.

Temporal and Spatial Changes in Milfoil Distribution and Biomass Associated with Weevils in Fish Lake, WI.

Laboratory Studies on Milfoil Weevil Host Preference, Performance, and Plant Damage, and Observations on Milfoil Declines in Minnesota.

Distribution of the Watermilfoil Weevil *Euhrychiopsis lecontei* in Washington State.

Factors to Consider When Using Endemic Biological Control Organisms to Manage Exotic Plants.

Panel Discussion: State Regulatory and Management Issues.

An Overview of the Aquatic Plant Control Research Program.

An Overview of Ecological Assessment Technology Area.

An Overview of Biological Control Technology Area.

An Overview of Chemical Control Technology Area.

An Overview of the Management Strategies and Applications Technology Area.

Evaluation of Four Herbicides for Management of Water Hyacinth and American Frogbit.

Efficacy of Clearigate and Reward, Alone and in Combination, on Free Floating Plants.

Residual Effects of Herbicides in Treated Water Hyacinth Used and Mulch.

Drawdowns to Control Hydrilla: The Lake Murray Experience.

Overview of Aquatic Plant Management in Washington State.

Growth of Vallisneria americana on Three Hydrosoils from Lake Gaston.
Fusarium sp. As a Potential Biocontrol Agent for Egeria densa and Egeria najas in Brazil.

Aquatic Vegetation of the Rio Parana, Brazil: A Functional Assessment.

Can Egeria Be Eradicated: Answer: Yes But Is It Worth It?

Spartina Management in the Northwest.

Remote Sensing and Mapping Application in Aquatic Plant Management.

The Algicide Tolerance of Filamentous Algae.

TAKE HOME MESSAGES

Aquatic weed harvesting is a viable method of weed control and greater emphasis needs to be placed on using them in conjunction with an integrated weed management program.

It is good to travel around the world to see how other countries tackle aquatic weed problems (if the opportunity arises, jump at it), however, don't sell yourself short. Weeds Officers in NSW often work in difficult conditions with limited resources and yet you manage to overcome some very difficult problems. Maybe the solution to your problem is closer than you realise, DON'T be scared to ask the "silly" question and don't be afraid to try something out of the ordinary (within reason). Last of all: Keep up the good work, someday we **WILL** be recognised for the great job we do!

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Mr. Don Doggett. South Florida Water Control District. Fort Myers, FL

GIANT SPOROBOLUS MANAGEMENT

David Officer
Pastures Research Officer
NSW Agriculture, Grafton

INTRODUCTION

The productivity and biodiversity of land on Australia's eastern coastal strip (>700mm rainfall) is being retarded by the rapid spread of Giant Parramatta grass (GPG)(Sporobolus indicus var major) in NSW and Giant Rats' Tail (GRT)(*Sporobolus pyramidalis* and *Sporobolus natalensis*) in Queensland. These species are a problem because there have low palatability for livestock and out-compete many native and introduced species resulting in grasslands which can be almost pure giant Sporobolus.

Australia's native Sporobolus species tend to be smaller than weedy types which grow to 2m in height. Giant Sporobolus species spread rapidly and can produce more than 100,000 seeds m^2. The seeds are sticky when wet. This property allows seed to be easily transported by machinery as well as both domestic and other animals. Fast flowing water will move seed but not wind. Vogler (pers. comm) has shown seed does not move more than 2m from the tussock without the aid of animals or machinery.

CURRENT AND PREDICTED SPREAD OF GIANT SPOROBOLUS

Both GPG and GRT were estimated to infest 250,000 ha in 1996 (Mears et al. 1996). Modelling work by Vogler et al. (1997) suggests GRT may establish in areas with rainfall as low as 500mm per annum. Currently GRT infests approximately 90,000 ha of coastal and sub-coastal land in Queensland, and it is predicted it could spread to up to 30% of Australia's land area (223 million ha). Although GPG is endemic in parts of the NSW North Coast, it is also found in isolated patches from Mackay to Nowra and inland on the NSW Northern Tablelands and North West Slopes. Both GPG and GRT will continue to spread but the rate of spread can be checked by increasing awareness of the problem and the need for care by individuals to prevent spread.

PREVENTION BETTER THAN INFESTATION

Know what your pest looks like

Being able to identify giant Sporobolus species is the first skill required to fight these persistent weeds. Identification brochures for GPG and GRT are available from NSW Agriculture and the QDPI. The NSW North Coast Noxious Weeds Advisory Committee has also produced a number of identification posters for both species which have dried specimens of these weeds and comments on why they are a problem. These posters are available from all member councils on the NSW North Coast.

Know how to prevent seed being introduced into your area

Sporobolus infestations can only begin if there is seed and a gap in the pasture or roadside in which it can establish. Be vary wary of buying stock, pasture seed or hay, or buying or hiring equipment from areas known to have GPG or GRT.

1. Buying stock: It is best to treat all stock introductions as potential sources of giant Sporobolus seed. Stock should spend at least 5 days in a quarantine area before being allowed access to the rest of a property. Remember to check the quarantine area for giant Sporobolus plants and remove them as they appear. Cattle spread giant Sporobolus because they eat seed heads and

2. seed sticks to their hide and in muddy hooves. Large amounts of GRT seed can be consumed by cattle (eg 8,300 GPG seeds/day; Andrews 1995) and some of this seed does germinate in thinly spread dung. We do not know how long seed will remain in animals coat hair, but the work with vehicular transport of seed suggests it will be retained until rubbed off or washed off by rain.

3. Buying pasture seed or hay: Introduction of pasture seed or hay can also bring with it giant Sporobolus seed. Avoid purchasing seed that contains Sporobolus seeds or where no certificate of analysis is available. The certificate of analysis is available from the seed vendor and gives a full description of seed viability and amount and type of weed seeds. Also avoid cheap grass hay from areas known to have giant Sporobolus.

4. Vehicles: Giant Sporobolus seed is readily transported by vehicles. Bray et al. (1998) showed killed seed sprinkled on a wet bull bar remained there for 9 days and 500 km. Ensure that all vehicles including those of contractors, are washed down before moving into land that is free from GPG or GRT. It is relatively inexpensive (~ $400) to buy a battery powered pump and tank which sits on the back of a ute and can be used for hosing down vehicles moving from infested to clean areas. Better still, avoid travelling through areas of giant Sporobolus especially in the summer/autumn period. If you must go through an infested area do so after the morning dew has dried and not after rain. A set of vehicle and machinery protocols is available for employees of utility companies, departmental employees and contractors to identify and minimise spread of GPG (Betts and Ensbey 1998).

BEATING POST-INFESTATION BLUES (FOR YOU AND YOUR NEIGHBOURS)

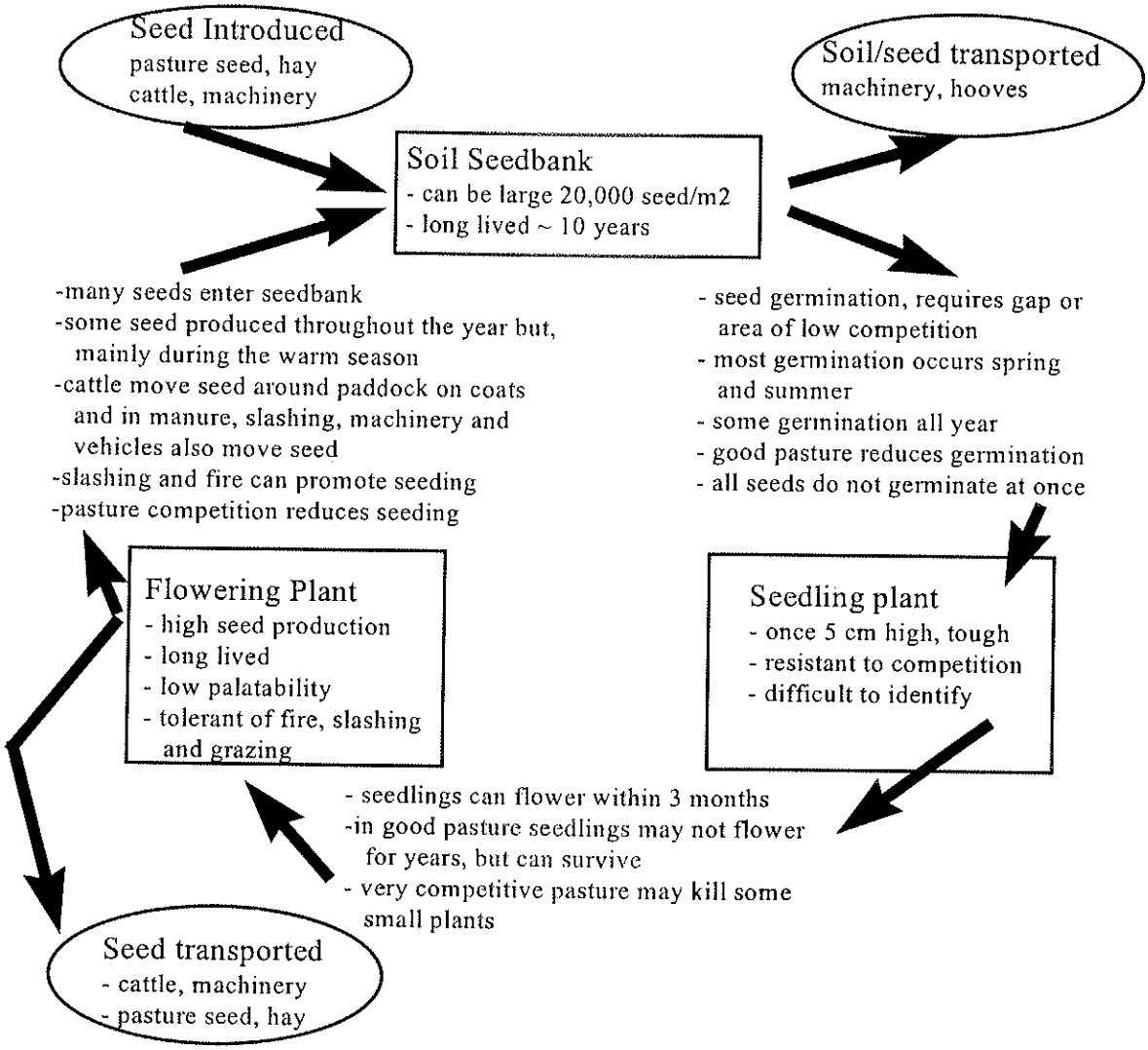
Know the life-cycle of giant Sporobolus weeds

To know how to manage a weed you must know it's life-cycle and potential weak points (Figure 1). Figure 1 highlights how seed is introduced; the factors influencing the soil seed bank and important characteristics of seedlings and mature plants. The critical point in spread of giant Sporobolus species is the introduction of seed into clean land which has been overgrazed, cultivated, sprayed or had a recent fire. New infestations generally occur in what was bare ground along roadsides and other high traffic areas. Other points to note about the life cycle of giant Sporobolus are described below.

Germination and emergence:

If giant Sporobolus species are to be controlled then the soil seed bank built up under a mature stand must be nullified. This means management of soil conditions must be manipulated to prevent germination of GPG or GRT. Wayne Vogler (PhD student, University of Queensland, Gatton) has been working on the seed ecology of GRT. Wayne's' work has shown:

- fresh seed takes 6 months to lose its dormancy and requires alternating soil temperatures (eg 15 to 35°C) to germinate. Therefore, seed produced early in the season can germinate later in the season.
- Fresh seed covered by soil requires greater soil temperature fluctuations to germinate than seed at the soil surface. As the seed gets older the size of the temperature fluctuation needed to initiate germination decreases.
- Infestations of giant Sporobolus increase after periods of drought and over grazing. Although most seedlings emerge in spring and summer, if moisture and temperature conditions are conducive, seedlings can germinate throughout the year.
- It is not possible to get all the seed bank to germinate at one time and even with continuous cultivation for 2 years some ungerminated seed will remain (Bray pers com).



Adapted from GRT Grass Best Practices Manual (draft)

Figure 1 Life cycle of giant Sporobolus plants

- Pre-emergent herbicides are incapable of killing ungerminated seed, killing only seed that is in the process of germination. Therefore, diligence is required for many years if control of giant Sporobolus is to be maintained.
- Sporobolus seed germination increases dramatically after spraying. Vogler has shown even if the pasture infested with GRT is burnt or mown, very few seedlings will emerge because there are established plants competing for the moisture (Table 1). If the pasture is either burnt or mown and then sprayed to kill existing plants, a large number of seeds will germinate. Increases in seedling emergence only occurs if there has been sufficient rainfall. On a dry site at Brian Pastures Research Station at Gayndah very few seedlings were counted on any plots. On plots irrigated fortnightly with 20 mm of water (given over a two day period) seedling emergence was observed in all treatments especially those where pasture competition had been removed.
- approximately 70% of GRT seed is located in the top 1cm of soil which means it is susceptible to damage by fire.
- Laboratory studies have shown it takes 125°C of heat for 15 seconds to kill GRT seed (Vogler et al. 1998).
- In practice a fire has been shown to halve a soil seed bank. Even though the seed bank can be halved by fire, there is still a large number of seeds left to germinate when conditions are favourable.
- The viability of giant Sporobolus seeds is over 90% and loss of viability is slow.
- It is estimated that some seed will remain viable for up to 10 years and therefore control strategies must identify means of preventing germination or removing new and established giant Sporobolus from pasture over long periods of time.

Table 1 Spraying increases germination of Giant Rats' Tail grass seed because both moisture and light competition from existing plants is removed (seedling numbers/m^2)

Site	Treatment			
	Burnt and Sprayed	Burnt	Mown and Sprayed	Mown
Gympie	52	0.4	66	0
Foxtail flats	40	0	214	0
Kilcoy	128	6	28	0
Brian Pastures	0	0	5	0
Brian Pastures (irrigated)	9	3	50	2

- **Management of germination and emergence:** Maintenance of good ground cover will significantly reduce germination and emergence by increasing the competition for water between established plants and seedlings and reducing soil temperature fluctuations. Fire is a tool to be used with care in the control of giant Sporobolus stands. Fire is useful to remove dry bulk and create a green pick for cattle and can reduce the soil seed bank, but if no other control measure is used fire can kill some useful species and increase Sporobolus seed production. A giant Sporobolus control plan must be incorporated into a farm's overall plan for the next 10 years.

Seedlings

- Steven Bray (Ecologist, QDPI, Gayndah) has been researching the plant ecology of GRT. He has shown if new seedlings are to survive, they need to grow where there is minimal competition especially for moisture. Early data from an experiment looking at the importance of competition from either roots or shoots suggests moisture stress from root competition can be more important than the amount of shoot. Despite this finding, seedlings of GRT are capable of withstanding

- considerable moisture stress and once they reach 5cm high are resistant to competition from other plants.
- GRT seedlings can remain immature for long periods if they establish under a tall sward. They have the capacity to wait until conditions are suitable and then flower. This means it can be very easy to miss these seedlings. For example, paddocks that previously had dense infestations which were controlled can have a sudden increase in visible plant numbers as retarded seedlings go into flowering mode. Once a plant establishes it can live for a number of years and rapidly produce a large soil seed reserve (GRT up to 20,000 seeds m^2).
- A selective herbicide which removes GPG and GRT seedlings from pasture or roadsides.

Flowering plants

- Established flowering plants are tolerant of grazing, slashing and fire.
- Fire burning with a fuel load of 4000 kg/ha can kill wilted seedlings up to 15cm and non-wilted seedlings up to 3cm high (Bray pers. com.).
- Fire and slashing can often increase seed head production.
- To minimise seed production giant Sporobolus plants need to be slashed every 2 to 3 weeks to prevent seeds maturing past the milk stage. However, it is cheaper and more effective to wick-wipe glyphosate as this will reduce seed head production even if the plant is not killed.
- A selective herbicide is required. At the present time (May 1999), there is commercial interest in manufacturing and distributing flupropanate (formerly known as Frenock). Flupropanate is a selective herbicide suitable for controlling GPG and GRT in all areas except pastures given to lactating dairy cows and recreational areas. It maybe some time, before the administrative hurdles required to register a new formulation are complete.

MATCHING YOUR CONTROL STRATEGY TO INDIVIDUAL CONDITIONS

The best strategy for control of GPG and GRT vary considerably depending on the level of infestation, existing pasture, type and level of production, type of land (eg arability) and soil type (Betts, 1997). A "GRT Grass Best Practices Manual" should be available from the QDPI late in 1999. It will contain recommended techniques on the full range of situations which confront people with GRT. Most of the principles in this manual should also apply to control of GPG.

The level of infestation (occasional plants, scattered plants and small clumps, dense infestations) and accessibility to machinery both affect the choice of control practice. Occasional plants can be removed by chipping out or be killed with glyphosate by spot spraying or with a hand held wick wiper. But once the infestation has scattered plants or small clumps of GPG or GRT then they are suitable for larger spray and wipe units. In dense infestations if sufficient desirable species remain in a paddock then the area needs to be wiped with glyphosate rather than boom sprayed.

Wiping

Pressurised wick wipers are useful in selectively removing giant Sporobolus from pasture. A program of wiping is required because total control is not achieved with one wipe. Some plants are not touched by the first wipe because they are too short and others don't get a full dose of chemical so they survive. The current recommendation for control suggests wipes at Christmas, Easter and the following Christmas. After this program of wiping the number of surviving plants should be thin enough to spot spray.

It is very important that desirable pasture species are grazed shorter than giant Sporobolus at wiping. Also the GPG or GRT should be growing actively and preferably have little rank growth. This minimises off target damage and maximises the leaf and stem area of Sporobolus receiving

chemical. Other recommendations for optimising kill of giant Sporobolus from wiping are described by Elphinstone (1995). In late 1999, John Betts from NSW Agriculture will have released an Agnote on use of a pressurised wick wiper for controlling GPG.

For land that is not suitable for cultivation the options for control are limited. Glyphosate may be applied by boom spraying or wiping followed up with over-sowing of competitive pasture species. For land that is inaccessible to vehicles economic options are restricted with hand application the only method available. In some circumstances, switching from grazing to forestry may reduce the amount of weed. GPG at least seems to be less aggressive under a forest canopy.

Pre-cropping and Pasture replacement

For arable land that is infested with giant Sporobolus a way of controlling it is to integrate cropping with grazing. For the best cropping regime in your area please contact your local district agronomist or agricultural adviser. On arable land in the North Coast of NSW, soybeans are the best summer crop option for most farmers wishing to control GPG. The soybean plant has a similar growth period to GPG and once established forms a dense canopy which prevents seedling emergence. There are chemicals available for control of GPG during cropping and after the cropping phase the seed bank should have reduced significantly. Soybeans improve the fertility of the soil and will often pay for the establishment of pasture after a 3-5 year cropping rotation. This approach of combining soybean growing and beef cattle production is known as Beef and Beans.

After the cropping part of the rotation is complete, a pasture species mix capable of competing against emerging GPG and GRT seedlings is required. Few species to date have shown promise as competitors against giant Sporobolus. The two species that have proven to be the most competitive against GPG are swazi grass (Digitaria didactyla syn swazilandensis) and bahia grass (Paspalum notatum). Both species have their draw backs, swazi must be planted by runners and bahia is very slow to establish and is considered by some to be a weed on good quality land. A selection program has commenced at Grafton to find a seeding line of swazi grass and a number of commercial and experimental grass lines are being tested as competitive species for GPG at 4 trial sites on the NSW North Coast by David Officer. A range of pasture species are also being trialed by Steven Bray for their competitiveness against GRT. So far the species which have shown the most promise against GRT are Keppel Indian blue couch, Bisset creeping bluegrass, Jarra digit grass, Callide rhodes grass and Floren bluegrass.

Living with GPG and GRT

Some producers, especially those with land that has poor productive value as a grazing enterprise, don't have the finances required to control endemic giant Sporobolus on their land. These people need information on ways of making GPG or GRT more productive without needing to outlay large amounts of money. In addition to improving productivity, hygiene must also be improved to prevent further spread of either GPG or GRT. Hygiene can be improved by establishing wiped or vegetative buffer zones (5m wide) and by following best management practices for movement of animals, pasture seed and hay and vehicles mentioned earlier.

Intuitively, a form of rotational or cell grazing should be able to maintain giant Sporobolus plants in a vegetative state for longer than occurs with set stocking. The nutritive value of the giant Sporobolus is at its best whilst it is short and green, but, as soon as it begins to "hay off" its' palatability declines. Some feed quality measurements have shown GPG is equivalent to poor quality naturalised species like carpet grass (Axonopus affinis). Unfortunately due to cost, no grazing studies have been conducted to date so the benefits and problems from rotational grazing

are unknown. As a part of a living with it approach There would also appear to be a role for the use of sub-lethal doses of glyphosate (1 l/ha) to reduce seeding and improve the palatability of giant Sporobolus.

TAKE HOME MESSAGE

- The cheapest and best method of controlling GPG and GRT is to avoid getting it in the first place.
- The earlier an infestation of GPG or GRT is identified and controlled after discovery the greater the chance of removing it permanently.
- To prevent invasion of either GPG or GRT be sure to quarantine stock, ensure all vehicles and machinery are free of seed, buy clean sowing seed and hay of known composition, create buffer zones between clean and infested areas.
- GPG and GRT are less likely to establish in a healthy pasture with good ground cover
- In areas already infested with giant Sporobolus be diligent in your control measures. Incorporate your giant Sporobolus control program into the overall farm plan for the next 10 years.
- Identify the control practices that suit your situation and be prepared to adjust your technique to suit each infestation site.
- If you have successes in control of GPG or GRT, let your neighbours, council weed officers and NSW Agriculture Agronomists know. Success breeds success and confidence.

ACKNOWLEDGMENTS

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REGIONAL WEED PLANING FOR THE GREATER RIVERINA REGION

Richard J. Graham
Riverina Noxious Weeds Project Officer
C/- Wagga Wagga City Council
PO Box 20, Wagga Wagga 2650.
grahamr@wagga.nsw.gov.au

INTRODUCTION

Funding obtained through the Regional Weed Action Program by the Eastern and Western Riverina Noxious Weeds Advisory Groups (which encompass 12 Rural Lands Protection Boards, 31 Riverina Councils and four Catchment Management Committees, from Tumut to the S.A. boarder) enabled them to employ myself to assist in the development and coordination of their regional weed management plans. These plans are being developed with the particular purpose of targeting resources to high priority areas. They are intended to provide effective, weed specific control programs utilising a regional strategic approach which aims to give focus through a series of planned activities with measurable (in terms of both financial and spread) / achievable goals and outcomes (Carter, 1997).

An *ad hoc* committee, made up of members from both advisory groups, met in early 1998 to identify a range of noxious weed species which they felt were of great enough regional significance to warrant the development of regional management plans for their control. Six weed species were initially identified for the management planning / submission process, being:

- spiny burrgrass (*Cenchrus incertus / Cenchrus longispinus*);
- St John's wort (*Hypericum perforatum*);
- blackberry (*Rubus fruticosus* L. agg.);
- silverleaf nightshade (*Solanum elaeagnifolium*);
- horehound (*Marrubium vulgare*); and
- wild radish (*Raphanus raphanistrum*).

This paper outlines the development and refinement of our regional plan structure, then outlines the formulation of plan content by key stakeholders.

DEVELOPMENT OF PLAN STRUCTURE

Upon commencement of the Riverina's weed management planning process in mid 1998, it was recognised that although there was some general weed planning structure available (e.g. draft state weed management plans etc.), there was no formal regional weed planning guidelines as such. As a result we sought to develop a hybrid plan structure which encompassed components of the national weed strategy and its draft weed management strategy guidelines, and, the NSW weed strategy and the structure used in the development of its state weed management plans. Our hybrid plan structure ultimately incorporated the required regional weed control plan structure provided by NSW Agriculture (Michelmore, 1998) and encompassed the following major headings:

- Cover Page (e.g. plans aim, objectives and assistance requested);
- Stakeholders and Budget Summary for Participating Councils;
- Background and General Facts (e.g. description of the problem, distribution of known infestations, weed biology, method and rate of spread and roles and responsibilities of stakeholders);
- Considerations (e.g. industry sectors, ecological, community, species management and linkages to other strategies);
- Barriers to Overcome to Achieve Each Objective;
- Action Plan;
- Declaration Change;
- Benefits and Costs;
- Monitoring and Review Process;
- Extension Material;
- References and Further Readings;
- Acknowledgments; and
- Disclaimer.

This structure, whilst including all required information, differs from the standard plan in that it incorporates a range of additional complimentary components. Components such as; considerations of the weeds impact on a series of factors like the community, the environment and a range of industry sectors; a monitoring and review process; and an outline of relevant extension material. It was felt that these additions give our plans extra body, whilst the monitoring and review component assists with problem identification and the maintenance of focus and accountability during the life of a plan, hopefully ensuring the aim and objectives are met.

PROCESS FOR FORMULATION OF PLAN CONTENT

Once we had developed and refined our plan structure, we held a daylong stakeholders workshop at Yanco to develop the content for our six plans. Participants were divided up into small groups and asked to develop an aim and range of specific, measurable and achievable objectives for each plan. They were then requested to identify barriers which needed to be overcome in order to achieve each of the objectives identified. Draft action plans were then developed, declaration changes where required identified and the benefits and costs of each plan recognised. All participants were then brought back into the one group to develop infestation maps of the type shown in Figure 1.

Draft information obtained at the Yanco workshop was then collated and forwarded to all local control authorities for digestion prior to a second stakeholder meeting some two weeks later. Plan content was reviewed at this meeting (attended by approximately 60 stakeholders) and participants were requested to forward comments to myself over the next eight weeks. At the completion of the review period changes identified (generally of a small nature) were made and plan general content completed. Plans were then checked by our Regional Noxious Plant Advisory Officer prior to submission.

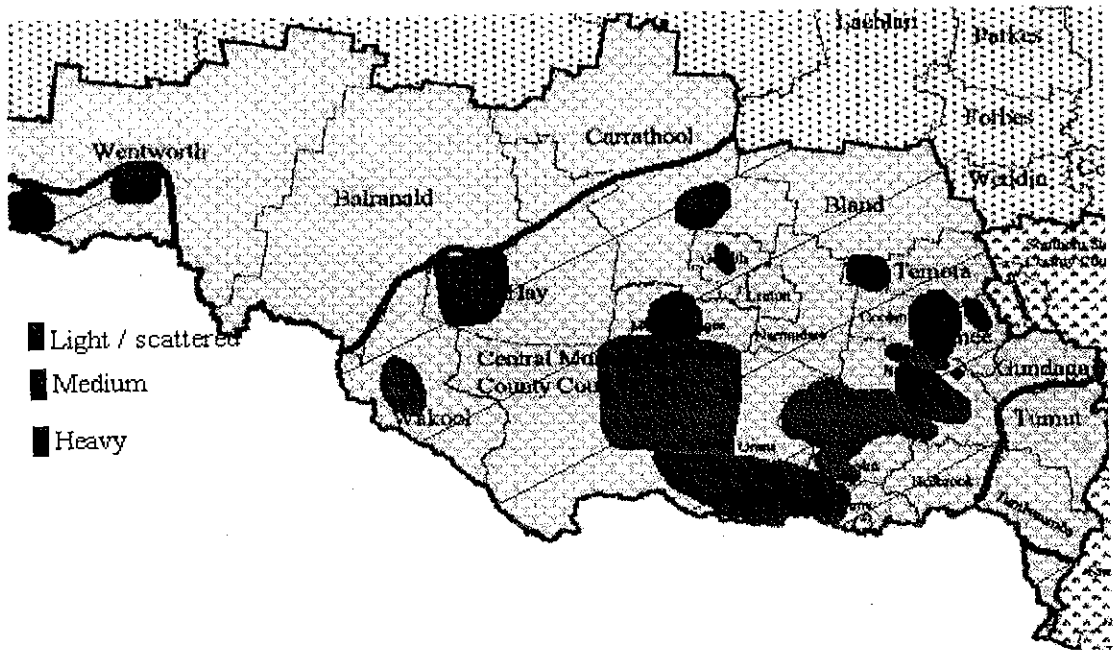

Figure 1 Area of Greater Riverina Region known to be infested with horehound. Level of infestation within this area shown as: light (weed is rare and occurrence is generally scattered), medium (weed is fairly common and occurrence is often several plants per m^2) and heavy (weed is common and occurrence is generally continuous).

Note: Base map courtesy of NSW Agriculture.

The above process was undertaken as it allowed plan ownership to remain with the various stakeholders making plans theirs rather than mine. Local plans, developed by plan participants were constructed in line with our regional plans and plug into them providing coalface / workplan content.

PLAN CO-ORDINATION AND IMPLEMENTATION

Once a plan has successfully passed through the submission process it will become my responsibility to co-ordinate the implementation of this plan. This will be done in consultation with the chairs of our Regional Noxious Weeds Advisory Groups and our Noxious Plant Advisory Officer. We will see that action plans are implemented by the appropriate people or organisations and that milestones are being met.

The monitoring and review process will not only seek to ensure that specific local actions, as outlined in relevant local management plans are being implemented, but it will also check that a plans overall aim and objectives are being pursued. Where necessary I will assist in the co-ordination of resource sharing between stakeholders.

TAKE HOME MESSAGE

Whilst it is extremely important to ensure stakeholders have input into the development of regional weed plans, giving them ownership, it is vital that the person or persons compiling such plans keeps stakeholders focussed otherwise a plans aim, objectives and actions may miss their mark, potentially rendering such plans ineffective or useless.

ACKNOWLEDGMENTS

I would like to acknowledge the assistance of:

- John Thorp (Project Manager, National Weeds Strategy) and Richard Carter (Program Leader Weeds, NSW Agriculture) for providing me with information which assisted in the development of our regional plan structure;
- all the stakeholders who assisted in the formulation and refinement of our various plans content; and
- Hugh Milvain (Noxious Plant Advisory Officer - Riverina, NSW Agriculture) for his input into the development of our regional weed plans.

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CHILEAN NEEDLE GRASS: IS IT MUCH DIFFERENT TO OTHER PERENNIAL GRASS WEEDS?

Tony Cook
Technical Officer (Weeds)
NSW Agriculture
RMB 944, Tamworth

INTRODUCTION

Chilean Needle Grass (*Nassella neesiana*, formerly *Stipa neesiana*) originates from South America, is a perennial weed, generally of pastures but can be of concern on roadsides, nature reserves and flood zones. This weed has characteristics similar to other well-known perennial grass weeds, such as Serrated Tussock, African Lovegrass, Giant Parramatta Grass to name a few. Chilean Needle Grass (CNG) has the ability to produce large quantities of seed, the seed can be disseminated in various ways, the seed can also persist several years (at least five years) in the soil and germinates from bare soil as is often found in poor pastures. Furthermore, once mature, the plant can be very competitive and becomes unpalatable to stock if flowering. The seed of CNG is capable of penetrating sheep skins, carcasses and eyes as a result of the sharp point 'callus' on the tip of the seed and the twisted awn (Bourdôt and Hurrell 1989), however experience on the northern tablelands of NSW have shown this to be rare.

CNG was first noted in Melbourne in 1934 then near Glen Innes in 1944 and the weed has since spread to localised areas throughout south-eastern Australia. It is estimated that CNG has the potential to spread over a much wider range of country than it presently occupies.

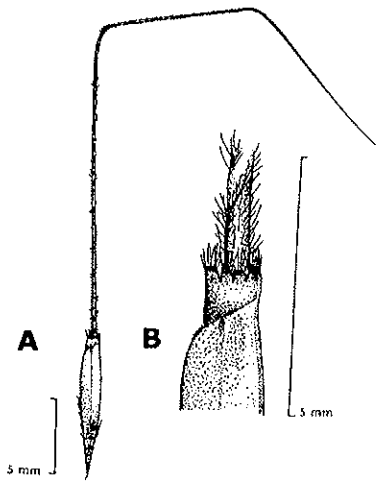
IDENTIFICATION

The first step towards controlling any weed is the identification stage. Ignorance about potentially new weed threats and/or the lack of community awareness can occur. An example of this ignorance and lack of identification occurred at Tamworth. An infestation of CNG was discovered in November 1996, and from the extent of the infestation the estimated age of the infestation was about 30 years.

Identification of CNG is very difficult if the plant does not have the characteristic maroon panicles. CNG commences panicle emergence in late spring/early summer and may have a secondary flush of panicles in autumn. A wet spring is likely to promote a proliferation of panicles, the secondary emergence of panicles in autumn is much less prolific. The key characteristics of this weed is found on the seed and spikelets. Firstly, the panicle appears maroon in colour due to the glumes (bract or membrane of the spikelet) similar to most stipoid grasses but the seed (without the awn) is approximately 10mm (see Figure 1(a)). Upon closer inspection of the seed, the unique feature of CNG is exposed, the corona, a tuff of hairs/tissue around the base of the awn (see Figure 1(b)).

Another feature of most stipoid grasses is the occurrence of cleistogenes (enclosed fertile seed). They are found under the leaf sheaths just above each node of any stem that has a panicle (Connor *et al.* 1993). In the case that the plant has lost their panicles but has stems remaining, the presence of these cleistogenes may assist in the identification process.

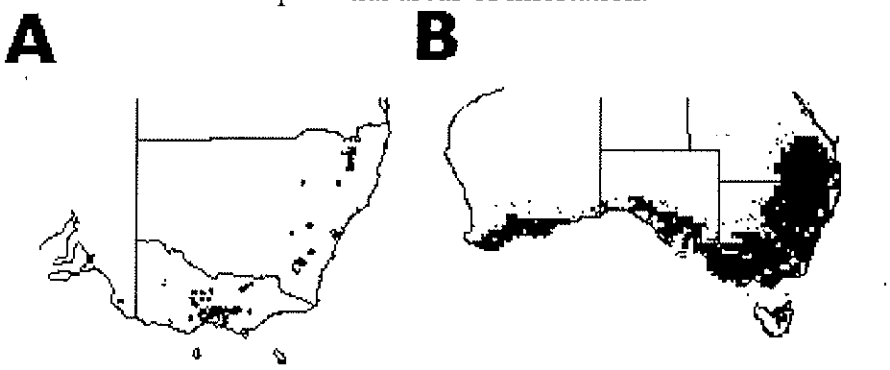
If the panicle is not present, the leaves of CNG are also good indicators. The leaves are generally rough to touch (scabrous), particularly if the finger is rubbed from the tip of the leaf to the base of the plant (Harden 1994). Another main feature is the evenly spaced hairs along the margin of the leaves, spaced approximately 2 to 3 mm apart.



Figures 1(a and b): Magnification of CNG seed showing the long awn (a) and the corona (b) at the base of the awn. Source: Grasses of New South Wales, Wheeler, Jacobs and Horton, University of New England, 1982.

DISTRIBUTION AND POTENTIAL INFESTATION REGIONS

Apart from infesting isolated parts of south-eastern Australia, CNG grows in other countries such as Argentina, Bolivia, Chile, Ecuador, Brazil, Uruguay, New Zealand, United States and England. CNG, being a native of South America, seems to have grown widespread in the South American countries it infests, reaching most of its biological limits. However, since the weed has only been in Australia for at least 65 years, the weed has potentially millions of hectares to infest. The figures below demonstrate the actual and the potential areas of infestation.



Figures 2(a and b): The actual distribution (a) of CNG obtained from herbaria records and the potential distribution (b) derived from a 'CLIMATE' modelling program. Source: McLaren *et al.* (1998).

BIOLOGY AND ECOLOGY

To successfully combat a weed a greater understanding of its biology and ecology are needed to find any weaknesses in the life cycle.

Strengths of Chilean Needle Grass

The seed bank of CNG grass is one of the major strengths in the weed's life cycle. The seed is considered moderately dormant and the rate of decline of the seed bank was 57% per annum (Gardener *et al.* 1996a). In essence, it would take approximately eight years without any additional seed input to reduce the seed bank by 99%. Data from Gardener *et al.* (1996b) has shown that CNG seed bank can range from 1000 to 12000 seeds/m^2. Assuming that 99% of the seed is exhausted from an original seed bank of 12000 seeds/m^2, after eight years there would be approximately 120 viable seeds/m^2 ready for germination.

It is not hard to imagine that once farmers have such dense infestations of CNG, eradication of the weed would be impossible due to the potential of re-invasion when particular situations favour germination. If, for example, CNG is removed and/or prevented from seeding for three years, it would only take a few years of an inappropriate or non-existent weed control program to allow seeds to germinate and/or existing plants to mature and produce enough seed to replenishment the seed bank. The reproductive ability of CNG makes this scenario more plausible because Storrie and Gardener (1998) have stated that CNG is capable of producing up to 20000 seeds/m^2. Seeds are likely to germinate in two distinct flushes, in spring and autumn (Bourdôt and Hurrell 1992) and are therefore likely to take advantage twice a year if the pasture is over-grazed or suffering from drought.

New infestations or the spread of existing infestations are predominantly caused by the movement of seeds, another strength of the CNG life cycle. The various vectors of seed movement are; sheep, water movement along water ways (flood zones), machinery (cultivation implements, slashers and transport vehicles) and humans (seeds in socks/clothing or baling of contaminated hay).

Other strengths of CNG include the ability to grow on both heavy or light soils. Furthermore, the adult plant is long-lived, very competitive in the warmer months and can tolerate droughts. The relative unpalatability of CNG in the inflorescence stage will enable it to set seed freely compared to desirable pasture species. This problem is further exacerbated if stock are set at low grazing pressures, a practice that most farmers are currently doing.

Weaknesses of Chilean Needle Grass

There are only a few weaknesses. Firstly, CNG is susceptible to a few herbicides, glyphosate in its many formulations and flupropanate (Frenock®). However, Frenock® was removed from the market leaving glyphosate, a non-selective herbicide as the only chemical option. Secondly, Gardener *et al.* (1996b) found that CNG can provide good quality feed at certain times of the year and that it is considered a desirable pasture species in Argentina. Therefore the adult plants can be weakened and possibly prevented from seeding.

MANAGEMENT OPTIONS

There is no literature available that states elimination of CNG is a possibility. All the strategies suggested so far have had the aim of minimising the long-term impact of CNG by either killing most of the adult plants and/or ultimately reducing seed production. The one thing in common with

most strategies is that they all involve tolerating low densities of CNG and avoided the 'kill all' approach.

Non-chemical management

Biological control is unlikely to be successful in Australia because CNG is closely related to many native grasses and there are few potentially useful agents.

Gardener *et al.* (1996b) recommended the cell grazing approach (high stocking rates for short periods followed by long periods of rest) to minimise the competitive edge of CNG. However, after an experiment conducted by Lowien *et al.* (1998) at Glen Innes, involving the use of heavy grazing to manage CNG, the seed bank increased by 51% in one year. It was concluded that favourable conditions caused rapid growth rates and unexpectedly high seed production. In summary, Lowien stated that solely relying on grazing management was unlikely to be a highly effective option. Direct drilling pasture after spray-topping with glyphosate was a more acceptable strategy, a 72% reduction in seed bank was reported.

Lowien *et al.* (1998) also found that cultivating to plant soybeans reduced the seed bank dramatically. The crop was competitive enough to minimise seedling re-invasion or development, however pre- or early post-emergence herbicides were also used.

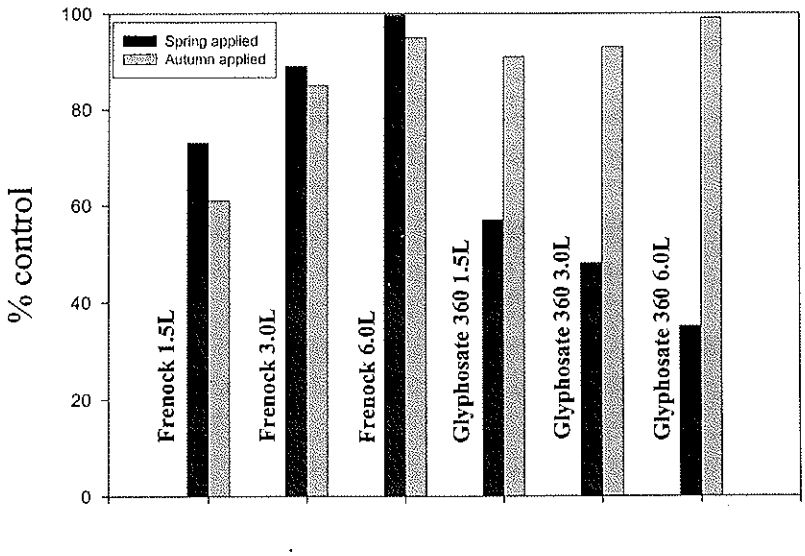
Chemical options

There is some potential for the use of herbicides to remove the initial infestation of adult plants. It will become more evident that post-herbicide management is required to maintain low levels of CNG.

To date, the bulk of the chemical research in NSW was achieved by the Northern Weeds Research and Demonstration Unit (McMillan *et al.* 1992). Not many options are available for removal of adult perennial grasses, usually there are only three herbicides; glyphosate, Frenock® and 2,2-DPA. Of these herbicides, Frenock® and glyphosate were the preferred herbicides for controlling CNG. Since the future of Frenock® is in doubt, most of the comments will be directed at glyphosate use.

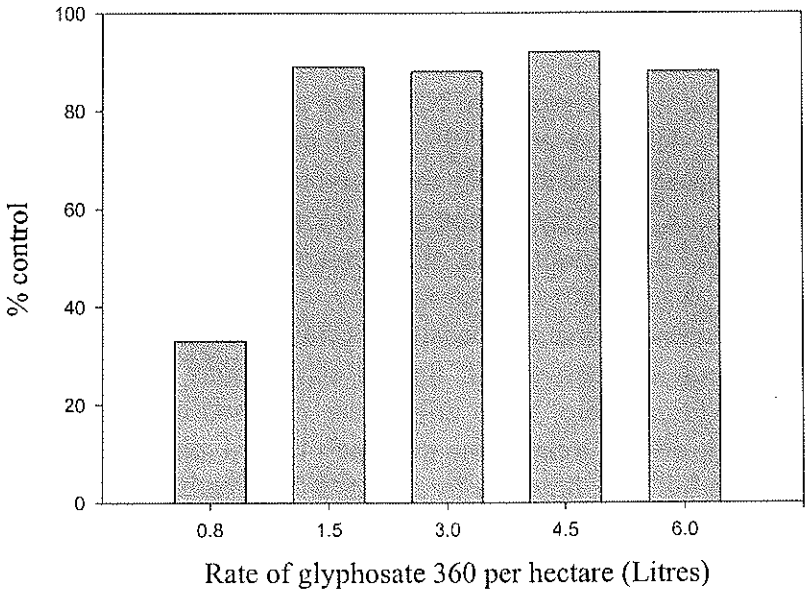
The seasonal effects of Frenock® and glyphosate on CNG, as seen in Figure 3, are typical of those seen on most other perennial grass weeds. Spring applications of Frenock® generally result in slightly better control. Alternatively, these effects are reversed and much greater for glyphosate applications. The strength of this interaction was such that glyphosate at 6L/ha applied in spring reduced CNG infestations by 30%, however by applying 1.5L/ha in autumn, control was near 90%.

The optimal rate of glyphosate, if applied in autumn, was 1.5L/ha (Figure 4). At this rate, some pasture species are suppressed, however pasture species were killed at higher glyphosate rates for no extra CNG control.



NOTE: Spring applied herbicides were applied in November and assessed 10 months after treatment whereas autumn applied treatments were applied in March and assessed 7 months after treatment.

Figure 3: Seasonal effects of Frenock® and glyphosate on the control of CNG. Source: McMillan *et al.* 1992.



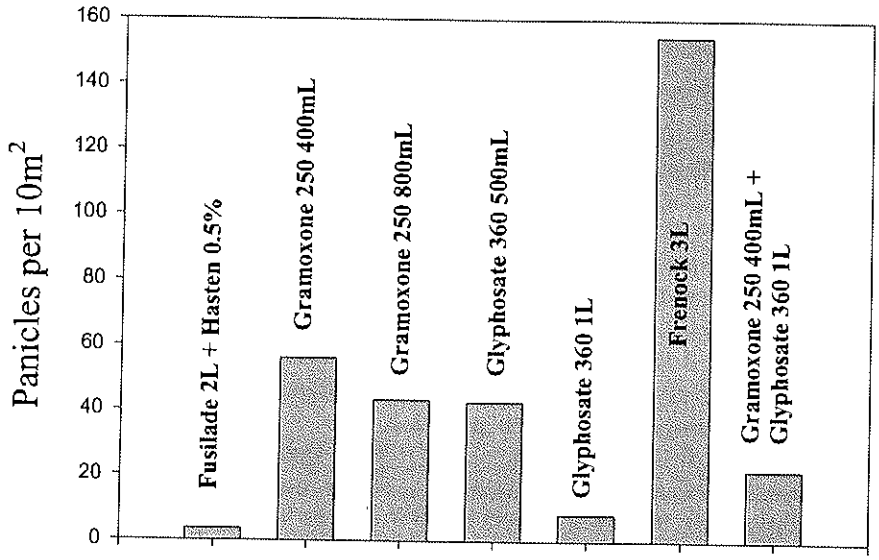
NOTE: Treatments were applied to CNG on 14th March and assessed 6 months after treatment.

Figure 4: Rate response of autumn applied glyphosate for the control of CNG. Source: McMillan *et al.* 1992.

Although, the results presented here seem impressive, control of CNG usually declines very quickly, about a year after application due to seedling emergence. It is essential that a competitive

pasture be established after herbicide application to limit the speed of seedling re-invasion. Clearly there is great potential for the use of wick wipers to selectively apply glyphosate to CNG. This technique needs to be researched thoroughly because it has proved very successful for other tussocky perennial grass weeds, controlling the weed and minimising pasture damage. A Pesticide Permit has been granted allowing the use of glyphosate through wipers to control a range of perennial tussocky grass weeds, including CNG.

Spray-topping of CNG may also help reduce the seed bank and slow the progress of seedling establishment. The results below (Figure 5) show that there are some effective herbicide treatments that greatly reduce CNG seed production. It is clear to see that contact herbicides such as Gramoxone® are not as effective as glyphosate or Fusilade®. Glyphosate has to be applied at 1L/ha for good results, however adding Gramoxone® may act as a good as a spray marker (faster brownout) but reduces control slightly. Frenock® had almost no effect on panicle production because it worked too slowly on growing points.



NOTE: Treatments were applied to CNG at early panicle emergence on 27th October and assessments were made 21 days after herbicide application.

TAKE HOME MESSAGES

- Eradication of CNG is impossible if the infestations are large and well established because the seed bank will persist for many years.
- Early identification of the CNG infestations is crucial if small outbreaks are to be successfully controlled.
- The weed has potential to spread to many regions in south-eastern Australia. Consequently, if an outbreak is detected, sensible on-farm quarantine is required (keep stock in holding paddocks/yards if potentially carrying CNG seed, minimise seed set, do not graze if plants are seeding, spray/wipe to kill plants etc). On a broader scale, roadsides must be checked, along with other high use access areas (residential areas, fertiliser depots, abattoirs and sale yards), and water ways.

- A decision whether to reduce CNG infestations or to accept the weed as a useful species must be made quickly and action to follow up the decision must commence immediately.
- One-off treatments are likely to result in short term (at best two years) control. This weed is persistent and therefore control strategies need to be equally persistent.
- It is likely that a successful control strategy would exploit several parts of the CNG life cycle. An integrated approach that combines pasture competition, minimises CNG seed production and kills CNG plants will be superior to a single strategy.
- Herbicides are a useful tool that can either kill existing plants or prevent seed production. Glyphosate is an appropriate herbicide for both these purposes. It is likely that wiper applications of glyphosate will be more widely adopted to reduce pasture damage. Applications of glyphosate are more effective in autumn.
- In essence CNG, is quite similar in most aspects to other perennial grasses. CNG can be utilised as a pasture species if managed correctly, but becomes less palatable when the plant begins to flower, prefers set stocking rates, out competes desirable pasture species, the seed is an important mechanism for dispersal and persistence, and finally the herbicides that are effective are also used to control other perennial grasses, reacting in a similar way.
- CNG has similarities to other problematic tussock weeds that are already widespread but it can be used as a successful pasture species if properly managed.

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WEED AWARENESS; WE ALL HAVE A ROLE TO PLAY!

Salvo Vitelli,
Department of Natural Resources,
Coorparoo, Qld

Toni Nugent,
Cooperative Research Centre (CRC) for Weed Management Systems
Farrer Centre, Charles Sturt University,
Wagga Wagga, NSW

Ursula Taylor,
Cooperative Research Centre (CRC) for Weed Management Systems
The University of New England, Department of Agronomy & Soil Science, Armidale, NSW

Bob Trounce,
NSW Agriculture,
Orange, NSW

1.0 Introduction

Awareness of practical weed management and other related issues form an integral part in the protection of agriculture and the environment. The incorporation of weed management information into National Weedbuster Week and its associated promotion will assist weed management messages reaching a larger audience who can ultimately become involved in protecting our primary industries and the environment.

This paper updates delegates on Weedbuster Week activities that took place in 1998 and lists groups that used the program to publicise their good work relating to weeds. By participating in Weedbuster Week your organisation can contribute to the protection of agriculture and the environment by promoting your weed management activities at the same time as other groups across Australia. All organisations are encouraged to link with Weedbuster Week to promote their practical weed management activities.

Weedbuster Week commenced in Queensland in 1994 with National Landcare Funding and support from the Industry, where it was identified there was a need to raise the profile and awareness of weeds and their effects on primary industries and the environment. The Weedbuster Week theme was extended to New South Wales (which had staged Weed Awareness Weeks on a number of occasions since 1986), and the Australian Capital Territory in 1997. With the support of the Cooperative Research Centre for Weed Management Systems (CRCWMS) and all States and Territories it expanded to become a national program in 1997.

Weedbuster Week provides an opportunity for community groups, private enterprise and government at all levels to promote their good collaborative work. The development of relevant weed information materials, and the distribution and promotion of these during Weedbuster Week is one vehicle available to increase the awareness of weeds. Information materials produced and promoted during Weedbuster Week are also available for use throughout the year for other on ground or education programs.

A national coordinator was appointed in 1998 with the support of the National Weeds Strategy Executive Committee through Natural Heritage Trust funding and is required to coordinate National Weedbuster Week, coordinate the development of National Weed Information Materials and promote National Weeds Strategy Initiatives. The National Coordinator works closely with a committee comprising of a member from each State and Territory and three CRCWMS Education Officers. It is proposed in the future that the National Coordinator establish a reference group consisting of government, industry and non-government representation to guide the committee.

The success of Weedbuster Week requires commitment from the community in rural and urban areas through organisations such as Landcare, Greening Australia, the Australian Trust for Conservation Volunteers, the CRCWMS, landholders, Local, State/Territory and Federal Governments, Private Enterprise and Industry.

2.0 Weedbuster Week 1998 Overview

Of the greater than 600 events/activities that took place across Australia, 150 of these occurred in New South Wales. Thousands of Australians attended, participated or visited a Weedbuster Week event/activity. These events/activities were organised by a variety of groups and highlighted that weeds are a key concern for rural and urban communities. Many groups joined forces in order to share resources and to demonstrate that effective weed management requires a united approach. A breakdown of group types is presented in Table 1:

National Weedbuster Week 1998 was sponsored by Monsanto Roundup, and launched by the Hon Dexter Davies MLC in Kings Park, Perth with over 150 participants.

The New South Wales state launch was carried out by Mrs Mary Moodie, presenter with Gardening Australia (ABC TV and Magazine) and an official party comprising of Dr Helen Scott-Orr (NSW Agriculture), Councillor Dick Niven (Mayor, Orange) and Mr Greg Wallis (Monsanto Aust.). The function was held at the Metro Plaza in Orange and was attended by many interested community members and special visitors such as David Hannard, (Councillor – Orange City Council), Reg Kidd (also a radio gardening presenter) and Mr Phillip Kingsley Miller.

Table 1. Participants in Weedbuster Week across Australia 1998.

Organisations	Number of participants
Local Governments	71
Australian Trust for Conservation Volunteers	4
Landcare and Coastcare Groups	68
Bushcare groups (Greening Australia)	23
Friends of groups	30
Conservation Groups	22
Scouts	19
Nurseries	2
Girl Guides and Brownies	8
High Schools	21
Primary Schools	122
Universities	1
Weed Science Societies	4
Waterwatch	1
Rainforestcare Management Groups	1
Aboriginal Community Groups	3
State/Territory Government Departments	20
Business outlets (AAMA Ltd. Mitre 10 [Northern], McDonalds [NSW, ACT])	> 400
Total number of groups	> 800

Events/activities run during Weedbuster Week 1998 included:

- On-ground weeding and replanting activities,
- Displays in shopping centres, Local Government Offices and libraries
- Weed Seminars,
- Field days and machinery days,
- In store displays,
- Media promotion,
- Weed Identification workshops,
- Weed fashion parades, and
- Competitions.

The support of Weedbuster Week participants and the media resulted in Weedbuster Week and related articles being printed in more than 5 million copies of newspapers and magazines, and 5 hours of television and radio coverage between mid-September and mid-October. The committee and event organisers generated a total of 200 known media segments. It was estimated that this information was seen or heard by greater than 1.5 million Australians.

Major publicity events included appearances by Bob Trounce, the NSW Weedbuster Week Coordinator, on the Midday Show with Kerry-Anne discussing plants that affect human health. The Weedbuster Week mascot Woody Weed, was also seen with scouts on Sale of the Century selling camping equipment to contestants. Target audiences were reached with the support of the ABC Gardening Australia and Landline programs and Australia All Over.

National Radio exposure was also generated through programs such as Triple J and the ABC Radio National Network. For the NSW launch, the ABC (2CR) and 2GZ interviewed all speakers. Gardening programs such as Reg Kidd (2CR) and Shirley Stackhouse (Sydney) and many others gave mention to weeds and Weedbuster Week.

A number of magazines such as Greenworld and Mitre 10 Gardener Club featured weeds and Weedbuster Week related articles. In many NSW city and country areas newspapers such as the Central Western Daily in Orange gave great support where event organisers made contact.

Four national competitions; an event organiser's competition, a school poster, colouring-in and herbarium competition were conducted. The national competition winners were split across Australia, with a New South Wales entrant from Hurleston Agricultural College winning the national herbarium competition.

Woody Weed had a busy campaign across Australia which further promoted Weedbuster Week and weed awareness. In New South Wales Woody Weed attended over twenty activities including:

- The state launch in Orange
- A segment with Kerry-Anne Kennerley on the Midday Show in Sydney
- Local Government activities
- Community group weed walks
- Presentations to school children
- Market visits and
- Field days.

New South Wales prepared two posters as part of the National Weedbuster Week campaign looking at:

- What is National Weedbuster Week? and
- Plants that harm our health.

A total of 2 800 Weedbuster Week posters and 3 500 human health posters were sent out to state coordinators around Australia as well as all NSW registered event organisers. The posters were mailed to all Mitre 10 Northern Stores and IAMA Rural outlets in Australia. McDonalds restaurants were supplied with sufficient numbers to give to all restaurants in NSW and the ACT. Four new weed bookmarks were also produced as part of Weedbuster Week by NSW.

3.0 How can Weedbuster Week assist you in practical weed management for the protection of agriculture and the environment?

Weedbuster Week is a national weed awareness week that aims to:

- Raise awareness and increase understanding of the problems weeds cause in key sectors of the community.

- Help the public to make the connection between their gardening, farming or grazing practices and potential land and environmental degradation.
- Provide the public with the information and skills required to play a responsible role in the sustainable use of land and water resources and ultimately make the necessary changes in behaviour to help the environment.
- Foster community ownership of problems resulting in acceptance and support for weed management projects.

A number of themes have been previously established and are shown in Table 2.

Table 2: Weedbuster Week themes.

Year	Weedbuster Program Theme
1997	General Awareness
1998	Recognition and Identification
1999	Prevention - prevent weeds from being introduced and becoming established
2000	Early intervention - getting on top of weeds before they beeome a problem
2001	Managing weeds and repairing the damage

In 1999, Weedbuster Week occurs from 10-17 October. The National launch will be in September at the Australian Weeds Conference. It is believed that launching the week in September will result in early interest from the community and increase possible attendance at local events across Australia in October.

"Weed prevention is the intention" is the 1999 Weedbuster Week slogan. This slogan is the key 1999 message that is being used to promote weed awareness for practical weed management projects.

4.0 Weed Information material

The use of promotional material, national, state or local weed awareness information and other available materials such as the Weedbuster Week character Woody Weed, add value to the overall Weedbuster Week project. At a meeting of the National Weedbuster Week Committee it was decided there was a need to develop integrated and coordinated weed awareness material that is available to all agencies and groups involved with weeds and their management.

The national weed awareness material is being developed by coordinators and will be adopted for national use when completed. The development and incorporation of weed information material that links to Weedbuster Week themes where possible on an annual basis is an effective way to distribute information to the community.

4.1 Proposed national weed awareness material

4.1.1 Posters

Three new posters are currently in development and should involve industry and target audiences as part of their development where possible. Each will be accompanied with an information sheet fitting the Weedbuster Week 1999 theme -prevention. A summary of the posters is provided below.

- ***Garden waste disposal***: The poster will raise awareness about the correct disposal of garden waste, and how this can play a part in preventing the spread of weeds.
- ***Aquatic plants and their legislative status***: The poster will raise awareness in the aquatic industry, and ultimately the community highlighting the different State and Territory legislation for the sale of aquatic plants. It is hoped it will assist in preventing their future sale.
- ***How weeds spread in rural areas***: This poster offers preventative methods to both urban and rural communities that can be incorporated into daily practices.

4.1.2 Booklets

- It is proposed that an existing Department of Natural Resources and Environment publication be adapted, that targets both the rural and urban community. The booklet identifies the methods of weed spread and offers suggestions of methods that can be used by individuals to prevent the further spread of weeds from or onto their properties.

4.1.3 Internet

- A national internet page currently exists that has been developed by John Thorp for the National Weeds Strategy and is located at www.weeds.org.au This site currently has a database of all known noxious weeds throughout Australia, in addition to an outline of the National Weed Competencies.
- This internet site may be developed further into a national weed porthole that links weed information from nominated sites. These could include Local, State and Federal Government, organisations, Greening Australia, Landcare and Coastcare, Herbaria, Botanical Gardens, and Industry. This site will link directly to relevant agencies and prevent frustration when searching for weed related information on the Internet.

4.1.4 Weed Identification Card Decks

- A standard, custom-made National Pocket Weed Identification Guide will offer user-friendly descriptions and excellent quality photographs for ease of identification. This product can be tailor made to service the needs of any agency involved in weed management. The National Pocket Weed Identification Guide will assist in the prevention of future weed spread through early identification.

4.1.5 CD Roms

- The possible addition of weed information fact sheets that are linked to a Queensland Department of Primary Industries managed CD Rom titled Prime Notes. The Prime Notes CD Rom currently includes fact sheet information from a number of agencies and businesses across Australia.
- It is proposed that interactive CD Roms first targeted at children and expanded to other audiences if accepted be developed.

4.1.6 Weedbuster Week Promotional Material

- As in past years a selection of Weedbuster Week promotional material will be available to event organisers at cost price. Materials include badges, balloons, stickers, t-shirts and caps.

4.2 CRC materials

- Weed Management Handbooks – wild radish, wild oats, annual ryegrass (to be written) and a generic Managing Weeds (IWM) booklet.
- Weed Identification Workshops.
- Integrated Weed Management Workshops.

- Pasture Weed Guide for managing weeds in southern Australian perennial pastures.
- Garden Waste Disposal Poster (4.1.1).
- Weed Navigator.

4.3 New South Wales Materials

- A general poster set is being prepared on weed management, showing how weed control is coordinated. It specifically shows the responsibilities of NSW stakeholders but links to National aims through the National Weeds Strategy.
- An additional set of bookmarks to complement the 14 in the current series will be designed, concentrating on telling the overall Weedbuster Week message/story and encouraging community action, rather than just listing a few more weeds.

5.0 Conclusion

The success of National Weedbuster Week is attributed to commitment from government, industry, the community and media. The challenge we face, is continuing the momentum already in place, to ensure the future protection of agriculture and the environment. The promotion of new and existing weed awareness material into Weedbuster Week is one way to increase the likelihood for its use at other times during the year. The development of weed information material and Weedbuster Week on-ground activities in collaboration with other agencies increases future partnerships, and improves resource use therefore reducing weed impact. Linking weed information material to Weedbuster Week themes provides an opportunity for it to be developed into a consistent package of material that adds value each year.

TURNING THEORY INTO PRACTICE - AN EXTENSION AND ACTION PROGRAM TO CONTROL MESQUITE IN FAR-WESTERN NSW

Joe Cummins
Senior Reserves Management Officer
DLWC Orange

Peter Gray
Noxious Plants Advisory Officer
NSW Agriculture Dubbo

Ross Sawtell
Reserves Management Officer
DLWC Dubbo

ABOUT EXTENSION

Extension is the process of building partnerships to achieve measurable changes in attitude and action about issues which the community sees as important. A modern extension program can have many elements, including the consultation, planning, investigation, community education, support, incentives and evaluation components.

This paper describes how these elements of extension have been applied in a practical way to implement a joint program between government and landholders for control of the declared noxious plant mesquite in far-western NSW.

About Mesquite

Mesquite (*Prosopis* spp.) is a native of North and South America. It mostly occurs as a thorny shrub about 3 metres high, but can also grow into a large tree up to 10 metres in height. A number of species including *P. juliflora, P. velutina* and *P. glandulosa* were introduced to NSW about 50 years ago for shade and ornamental purposes around homesteads, and for revegetation and mine restoration projects. Mesquite grows relatively slowly and it can be 3-4 years before plants flower and set viable seed. It poses a significant threat to the pastoral lands of western NSW because:

* it is well-suited to semi-arid conditions
* it spreads significantly and forms impenetrable thickets
* stock mustering and access to watering points is made difficult
* the productivity and value of pastoral lands is reduced
* mature plants set large amounts of seed which is easily transported and can lie dormant in the ground for many years before germinating in a favourable season

Mesquite is already a serious problem in America (28 million hectares) and in Queensland, where some 500 000 hectares are affected to some degree. In NSW, infestations occur on public land and about 35 Western Lands leases around Broken Hill and north to Milparinka, with some 25 000 hectares affected.

Recommended control methods

Mesquite can be controlled by grubbing, pushing or chemical means. Scattered plants can be grubbed out to a depth of 20cm when soil conditions are favourable. Larger trees can be bulldozed. Chemical treatment can be by basal spray in the warmer months with a mix of distillate and Garlon, Invader or Access. The cut stump technique is also effective, especially on larger plants. Overall foliar spraying is recommended for treatment of dense stands of seedlings.

Chemical control recommendations are:-

Application method	Tradename/ Herbicide	Rate	Optimum stage and time	Comments
Basal bark	Garlon 600 (R) or Invader 600 (R)	1L/60L diesel	Plant must be actively growing	For plants up to 20cm stem diameter. Wet ste thoroughly from ground to 45cm height
	Access (R)	1L/60L diesel	As above	For plants up to 5cm diameter. Wet stem thoroughly from ground to 30cm height
Cut stump	Garlon 600 (R) or Invader 600 (R)	1L/60L diesel	Any time of the year	Stems should be cut close to ground level and treated immediately
	Access (R)	1L/60L diesel	As above	As above
Overall spray	Grazon DS (R)	350ml/100L water plus wetting agent	Plant must be actively growing	For plants less than 1.5m tall. Do not spray plants bearing pods. Spray leaf and stems to the point of runoff.

Source: Peter L. Jeffrey Queensland Department of Primary Industries and Energy (DPIE)

Biological control by the mesquite leaf-tier *Evippe* sp. and the sap sucker *Prosopidopsylla flava* is under investigation by the CSIRO Division of Entomology and the Alan Fletcher Research Station in Queensland. Releases of these insects were made on mesquite infestations in the Broken Hill and Milparinka areas during 1998, however it will be several seasons before the effectiveness of these agents is known. It is not expected that biological control agents will be effective in the control of widely scattered plants.

Background to the program

The Department of Land and Water Conservation (DLWC) is the weed control authority in the parts of western NSW which are not in a local government area (the unincorporated area). Mesquite is a declared W1 noxious weed throughout the Western Division and landholders are obliged under both the Noxious Weeds Act 1993 and the Western Lands Act 1901 to fully and continuously suppress and destroy it. Historically, few landholders undertook control work, as there was a common perception that it was not a very serious problem and many landholders considered that control of mesquite was the responsibility of the Government.

DLWC rangelands management staff at Broken Hill have a good knowledge of the infestations, and during the 1980s and early 1990s undertook comprehensive control work on the most severe infestations each summer, in order to prevent larger plants reaching maturity. This program was discontinued in 1992, as it was considered that the infestations had been reduced to a level where maintenance treatment should be undertaken by each landholder.

A NSW Agriculture group visited Charleville and Quilpie in 1995. They were alarmed by the level of infestation in these areas, and were convinced that a similar threat existed for NSW. This concern was shared by DLWC Far West Region staff at Dubbo and Broken Hill. It was deemed vital that a program be implemented to ensure that the remaining relatively low numbers of plants in NSW were eradicated.

About the action program

NSW Agriculture and DLWC agreed to work together to design an extension and action program for mesquite, involving all levels of government, community groups and individual landholders. It

was agreed that the main aims of the program were to progressively eradicate existing mesquite infestations and to protect other land from invasion. The key tasks were to
eradicate all mesquite plants of flowering age from NSW by the end of the 2000/2001 season, and then to control all reported occurrences as soon as possible after detection.

Education of the wider far-western community was also seen to be necessary, so that both townspeople and landholders without a mesquite problem were made aware of its invasive nature and became vigilant in reporting untreated or new problem areas.

The elements of the extension program are:

Consultation

It was evident that mesquite would not be eradicated unless the affected landholders became aware of the threat to their holdings and took a leading role in implementing control measures. A change of attitude was required. The Pastoralist's Association of West Darling and the Broken Hill and Milparinka Rural Lands Protection Boards were identified as the most appropriate local organisations to represent the landholders. When approached, these organisations acknowledged the threat posed to all landholders and willingly became active partners in the program.

A briefing was prepared for the Minister for Land and Water Conservation as Minister for the responsible Department, and his endorsement of the proposed program was secured.

The NSW Noxious Weeds Advisory Committee (NWAC) is the leading statutory body advising the Minister for Agriculture on weeds issues. State land management agencies, local government and community interest groups are represented. The NWAC members were aware of references to the mesquite threat in the National Weeds Strategy, and unanimously endorsed the proposed NSW program. Because of the small number of landholders involved it was possible for NWAC to send a personal letter to each affected landholder, urging their participation.

Planning

A comprehensive Weed Management Plan has been completed for mesquite. This describes the problem and the control methods available, identifies the stakeholders and outlines the objectives, key tasks, timelines and funding guidelines for the program. Such plans are now being developed for many weeds of State and Regional significance, so that the process of declaration and the resources available for weed control programs can be better managed.

Investigations

An extensive literature search was undertaken, establishing the incidence and severity of the mesquite problem both worldwide and in Australia. The results of trials undertaken and recommendations made in Queensland were used in formulating preferred treatments for NSW. NSW Agriculture re-issued an *Agfact* which outlined the problem, features of the different mesquite species, methods of control and recommended rates and times for chemical application.

Local investigations carried out by rangelands management staff were also used to determine the best options and preferred times for treatment in the Broken Hill and Milparinka areas.

Community education

Substantial articles about mesquite were published in the *Barrier Daily Truth* and the *Western Division Newsletter*, which is sent to all lessees in the Western Division. DLWC Western Region staff were interviewed about mesquite and the co-operative scheme on radio station 2WEB (Western Education Broadcasting) on a number of occasions.

A most successful Mesquite Field Day was held in October 1998 at "Langwell Station", 60 km south of Broken Hill. This was a joint initiative of the Broken Hill Rural Lands Protection Board, DLWC and NSW Agriculture. All affected landholders were personally invited, and a 75% attendance rate was achieved. An Australian authority Mr. Peter Jeffrey, then Research Information Officer, DPIE Charters Towers, Queensland outlined the present and potential range of mesquite and demonstrated practical methods of control. The evidence presented on this day was a significant factor in convincing many landholders to embrace the control program.

Support:

Landholders are assisted by DLWC staff to determine an achievable annual program. As the program proceeds, the Rangelands Management Officer responsible for many of the affected holdings makes field inspections and gives practical advice and encouragement to landholders.

Incentives:

Because of the national significance of mesquite, financial support was provided to landholders who undertook control programs. Landholders were assisted with the initial costs of treatment, mainly spraying, on the basis that an agreed continuing control program would be maintained at the landholder's expense. Funds were contributed by DLWC and NSW Agriculture through the Noxious Weeds Advisory Committee for this purpose.

Reimbursement of part of the cost of each day's control work is made through the Broken Hill and Milparinka Rural Lands Protection Boards on production of documentary evidence. This financial support will cease after the 1999/2000 season.

Evaluation:

The levels of participation and progress by landholders are monitored during and after each control season. Receipts, records of materials used and time spent are kept by the landholders. Records are kept of areas treated and success rates. Incidences of reinfestation are noted and landholders are being encouraged to implement follow-up work in the next season.

Overall progress against the program aims and an analysis of the resources needed to complete the program within the designated timeframe are evaluated after each control season.

By the end of the 1998/99 summer 20 landholders were participating in the control program. Records show that the worst infestations are greatly reduced, and many thousands of scattered plants have been treated. Most plants of flowering age have received treatment. It is expected that all remaining significant infestations will be treated during the 1999/2000 season, leaving only isolated or new plants to be continually detected and eradicated by each landholder.

Take Home Messages

DLWC as the local control authority for this area of the Western Division has a legal obligation to ensure that weed control work is carried out. Western Lands lessees are obliged to implement control programs and ultimately legal proceedings could be taken to enforce this responsibility. However the increased knowledge and vigilance of landholders resulting from this extension and action program has reduced the likelihood that this course of action will be necessary in the Broken Hill and Milparinka areas in the foreseeable future.

Several positive factors made this program achievable. The locations of the infestations were well known. Effective control methods have been documented. Personal contact was possible with the 35 affected landholders. Local organisations were willing to represent the interests of the local people and help administer the program. The participating government and community organisations were made aware of the threat and have a common aim to eradicate mesquite. The costs were shared and sufficient funds were made available to support an incentive program.

The extension strategy was designed around the conditions which prevailed, and different strategies would be appropriate in other circumstances. The flexibility to adapt a strategy to suit the prevailing situation is a cornerstone of any well planned extension program.

Acknowledgments:

The central roles played by DLWC Far West Region staff Peter Walker (Dubbo) and Eric McCormick (Broken Hill) in the design and implementation of this program are acknowledged. The active support of the Broken Hill and Milparinka Rural Lands Protection Boards and the Pastoralist's Association of West Darling are also acknowledged, as is support given by senior NSW Agriculture staff and the Noxious Weeds Advisory Committee.

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NEW CODES OF PRACTICE FOR PESTICIDE USE

Ross Hampton
OHS Adviser
NSW WorkCover Authority
Sydney

ROLE OF WORKCOVER

The NSW WorkCover Authority has roles in regulating workers compensation insurance and occupational health and safety. The Authority is also responsible for development of new laws, which is often done in consultation with other states through the National Occupational Health and Safety Commission.

Since July 1998, WorkCover is controlled by the NSW Workers Compensation Advisory Council, which determines policy. The council is advised by 12 Industry Reference Groups, which cover all industries, and the Occupational Health and Safety Council. These bodies are comprised of employer and employee representatives, who represent you.

The changing nature of regulations

Older Acts and regulations are being repealed – including the Fumigations and Pesticides Regulation, originally under the Public Health Act. This old regulation was very prescriptive, written in language that was difficult to understand, and some times the intent of a particular provision was obscure.

Regulations are changing from being prescriptive to being performance based. Regulations are now designed to emphasise outcomes – in the case of occupational health and safety, regulations specify the approach to be taken and the standards that must be met. Regulations are now designed to be more flexible to allow for differences in workplaces and work practices. This means that the way of achieving the standards set by the regulation - the performance – is up to you. In the older regulations the performance was prescribed. Codes of practice now help you do this.

In some cases the regulations specify the standard that must be reached, such as the exposure standard, in order to limit the total exposure to any particular chemical.

Central to this performance-based approach is the assessment of risks, within an overall perspective of risk management. Risk management is an approach now being used in relation to all types of risks. You should consider using this approach in relation to all the risks faced by your business.

In lots of ways you probably do this already without calling it risk assessment and risk management.

Current regulations relating to chemicals and pesticides

Key legislation is the Pesticides Act 1978 and Regulations, administered by the EPA, which will be amended in the future. Currently there is an inquiry being conducted by the Upper House of Parliament into the use of pesticides in agriculture.

WorkCover administers a number of regulations. The main one relevant to pesticide use being the *Hazardous Substances Regulation* under the *Occupational Health and Safety Act.* Also relevant where large amounts of pesticides are stored is the *Dangerous Goods Regulation* under the *Dangerous Goods Act.*

The terms used here need explanation. There is a difference between hazardous substances and dangerous goods, although the categories overlap, particularly in the area of acute poisons.

The focus of the definition of hazardous substances is on health effects, including long-term effects, while the focus of the definition of dangerous goods is on immediate danger and includes the physical effects of fire and explosion. Hence flammable liquids are dangerous goods, and a flammable liquid such as xylene is also hazardous to health on the basis of its toxicity.

These classifications apply to all components of a mixture and not just the "active" ingredient. For example, a pesticide dissolved in a flammable liquid is a dangerous good, even if the pesticide active ingredient is not toxic.

The classifications also depend on concentration. When diluted to use strength, most pesticides are not classified as hazardous or dangerous. However, hazards may arise during use – such as the risk of inhalation of spray mist. The hazardous substances regulation brings the Worksafe exposure standards into law – the exposure standards must not be exceeded. The *Hazardous Substances Regulation* requires exposures to be kept to a practicable minimum.

Some herbicides are neither hazardous nor dangerous, so it is important to be aware of the classification before deciding how the regulations apply.

The control measures for dangerous goods focus on physical containment, such as packaging or bunding (spillage control) of liquid storage areas. The control measures for hazardous substances focus on reducing exposure, such as using protective equipment.

Risk management approach of new regulations

This new approach is common to all newer regulations. Generally the risk assessment applies to employees, and others working at the place where the pesticide application is being carried out. Self-employed persons do not have a duty of care to themselves and so a risk assessment is not required in relation to their own exposure, although it is recommended.

The steps in risk assessment are:

- identification of the hazard (from the label)
- assessment of the degree of risk posed by the hazard
- adoption of suitable methods to control the risk (eg protective equipment)
- evaluation of the control methods (eg health checks).

In practice, for chemicals intended for end use such as pesticides, the supplier is obliged to provide health and safety information in the form of:

- the label
- the Material Safety Data Sheet (MSDS)

In most cases the MSDS should provide adequate information on suitable control measures. The risk assessment is based on this information.

The supplier of the substance must provide you with MSDS for the hazardous or dangerous substances you purchase, if they are for use at work. Retailers such as hardware shops and supermarkets are exempt from this requirement, but the usual resellers of pesticides and other agricultural chemicals must provide you with MSDS on first purchase and on request. The manufacturer or importer must provide the MSDS on request. Many manufacturers and importers now put the MSDS on the Internet.

Codes of practice assist in doing the more complex types of risk assessment.

NEW CODE OF PRACTICE

To provide guidance on applying the regulations, WorkCover has introduced two new codes of practice, focused on end users:

Code of Practice for the Safe Use and Storage of Chemicals (Including Pesticides and Herbicides) in Agriculture

Code of Practice for the Safe Use of Pesticides Including Herbicides in Non-agricultural Workplaces.

These two new codes of practice aim to promote safe and healthy practices in the use, storage and transport of pesticides (including herbicides), and other agricultural chemicals. They came into effect on 1 September 1998.

The codes relate to the use of those chemicals classified as hazardous or dangerous.

As the titles suggest, the codes are aimed at two different types of workplaces.

Agricultural workplaces

The first code covers all types of agricultural chemicals used in all sectors of the agricultural industry. This includes broad-acre high-volume use. It is aimed at farmers, pastoralists, horticulturists, orchardists, foresters and those in wholesale nurseries.

It covers chemicals commonly used in agriculture including substances such as pesticides, fertilisers, fuels, disinfectants, and cleaning agents.

Non-agricultural workplaces

This code of practice applies to persons working in industries such as urban pest control, gardening and green keeping. Persons who will find this code useful include contractors, local government councils, grounds persons and green keepers who use pesticides as part of their work duties.

The non-agricultural code covers applications both in the field and within and around buildings. Usually this use is of a smaller scale than agricultural use.

The codes do not cover the manufacture, distribution or warehouse storage of pesticides prior to purchase by the end user.

Focus of new codes

These codes of practice provide practical and informative guidance on applying a risk management approach to work involving pesticides and other chemicals. They will assist users comply with the *Hazardous Substances Regulation*, the *Dangerous Goods Regulation* and the *Pesticides Act*.

The codes are designed to be more user-friendly than regulations. They provide check-lists and advice on how to control risks.

They will assist users to minimise detrimental effects to human health and the environment by suggesting ways to assess and control risks. Central to this approach is the identification of hazards from labels and Material Safety Data Sheets (MSDS). For most users, following the control measures recommended on the pesticide label and MSDS will complete the risk assessment. Regular health checks are recommended for people who use chemicals every day.

The control of storage risks is also covered in the codes in relation to those pesticides and chemicals classified as dangerous goods, including fuels.

If the pesticide is not classified as either hazardous or dangerous then a risk assessment is not necessary in relation to the chemical hazards. You may need to assess other types of risk such as those related to plant such as tractors or vehicles.

The codes are also consistent with relevant environmental legislation in relation to use and disposal of pesticides. They aim to provide a single source of advice so that users will not have to consult several documents when using pesticides.

To assist the reader, the codes provide a number of checklists, and some suggested charts for record keeping are provided.

OHS professionals, trainers, educators, medical practitioners and government officers will also find that these codes provide useful background material, which will assist in providing advice to their clients.

Contents of the new Codes

The codes contain chapters on:

- legal responsibilities
- consultation with employees and contractors on applying the code
- risk management in your workplace
- identifying hazards, including labelling
- assessing risks, including health checks
- control measures

- training employees
- transport and storage risks
- dangerous goods storage and licensing
- planning emergency procedures
- keeping records

In appendices

- sample record forms
- examples of factors to consider in risk assessment
- examples of suitable records
- check lists

The codes are available free of charge from the WorkCover bookshop, telephone 1800 658 134, fax 02 9370 6127.

Penalties and inspector's notices

There are no penalties for failing to comply with a code of practice, but it can be used as evidence in prosecutions. A range of penalties is provided by the Occupational Health and Safety Act. Inspectors also have the enforcement tools of prohibition or improvement notices. The action taken by an inspector would depend on the seriousness of the matter and the need to prevent on-going breaches of legislation.

In the case of death or serious accident or injury, WorkCover will usually prosecute the employer, or in some cases a self-employed person if their actions were relevant in causing injury to another person. Fines for breaches of regulations are usually much less than in the case of prosecutions for breaches of duties in the Act. In relation to less serious matters there is also provision for 'on-the-spot" fines.

In order to correct unsafe matters or procedures, WorkCover inspectors have the power to issue improvement notices. Prohibition notices are issued where an inspector considers that work should cease until an unsafe matter is rectified. Codes of practice can be referred to in improvement notices as a practical way of meeting the requirement of the Act or regulations.

Sometimes both prosecutions and notices are used in relation to the one incident.

WorkCover has policies to assist inspectors decide on enforcement and prosecution actions and a summary of these is available to the public.

WORKING WITH COMMUNITY GROUPS

Terry Schmitzer
Noxious Plants Offices
Hastings Council
Port Macquarie

COUNCIL AREA

Hastings Council covers 3,705 square kilometres on the North Coast of NSW, consisting basically of the catchments of the Hastings and Camden Haven Rivers including the Wilson, Maria, Pappinbarra, Forbes, Ellenborough and Thone Rivers which contribute to the former.

Topography is generally undulating to hilly, with a flat, swampy coastal zone and steep and rugged western area.

The Council area has a population of approximately 60,000 with centres of population being Port Macquarie, Wauchope and Laurieton/North Haven. Seaside villages include Bonny Hills, Lake Cathie and rural towns of Kendall, Kew, Comboyne, Long Flat, Beechwood and Telegraph Point.

Of the 3,705 square kilometres, Council is responsible for 2,110 square kilometres with National Parks, State Forests and Crown Land making up the balance.

There are currently 15 Landcare Groups, 7 Coastal and Estuarine Dune Care Groups and several specific purpose conservation groups within the Hastings Council area.

It is to be noted that not all of these groups have working relationships with Council.

Working With, Not Apart From, The Community

Council recognises that given the area it has to cover for weed control and the current structure of available resources, (one full time weeds officer, one part time weed inspector and utilising contractors to undertake the majority of spray works), that a working relationship with community groups would enhance the program results through increased community consultation, participation and knowledge of control works.

This proactive approach has proven to be most beneficial in providing a sense of ownership and avenue for input into the daily activities of the weeds program for individuals and groups.

Types Of Groups

The Groups which are currently active within the Council area include the following :

Total Catchment Management Committees
Landcare Groups
Dunecare Groups (Coastal & Estuarine)
Conservation Groups
Progress Associations

Where Do Groups Fit Into Your Program ?

Most groups are issue driven and most groups are driven by one or more significant individuals.

Where the issue falls under the broad spectrum of weed control, there is an opportunity to enlist the enthusiasm and resources of the group into your broader program. It is to be noted that you may have to alter, sometimes significantly, your program to accommodate the specific issue or project, however the results can be spectacular and rewarding for all parties.

There are times when an issue or a project may need to be sold to a group. Should this situation arise, it is important that there are benefits for both the community and Council as without a sense of ownership in the project the degree of benefit will be reduced.

Basic Guidelines

X Start small and short term with measurable milestones. If this is not what is originally proposed it may be necessary to break down a larger project into smaller segments. If projects are large and drawn out the group will lose interest.

X Clearly define which tasks are the responsibility of the Group, Council and any others which may be involved so as there is no confusion as to who is doing what and everyone knows where they fit in.

X Reward/recognise the achievements of measurable milestones. The media is interested in publishing stories of Community Group achievements.

OTHER BENEFITS

Increased public awareness and perceived community ownership of specific areas is probably the greatest long term benefit.

Public policing (peer pressure) of weed control, reporting of new and emerging weed problems on Council controlled land.

Additional funding opportunities are available for certain projects through the community groups, eg. National Heritage Trust, Landcare, Coastcare.

Shared workload - groups may take on tasks, roadside inspections etc, which will free up some of your time.

PAST & EXISTING PROJECTS

Total Catchment Management

X The Hastings Council and Hastings/Camden Haven Total Catchment Management Committee have a joint Weeds Task Group which meets bi monthly to discuss weeds issues relevant to the area and formulate actions to address such issues.

The group has representatives from Council, TCM., Landcare, Dairy Farmers, Rural Lands Board, Cattleman's Union, NSW Farmers, Hastings Beef Producers, Conservation Society, Wauchope Stock & Estate Agents, State Forests and Department of Land and Water Conservation.

Council uses the group to provide input into its noxious weeds and other associated programs, consultation with policy and procedure documents eg. Herbicide use policy and Giant Parramatta Grass Control Guidelines.

Total Catchment Management Committee uses the group for consultation on funding (weed related) issues and interaction with members on weeds issues. Issues of regional significance or addressed to specific government agencies can be channelled back through the TCM to departmental representatives at regional and state level.

X Joint field days have been conducted utilising the combined resources of TCM and Council particularly in respect of Giant Parramatta Grass with resulting increased attendance etc.

X Multi pronged voice/platform to address issues of importance with government representatives.

Landcare

X Participation/input into spray control programs eg. Giant Parramatta Grass. This involves both advising of problem areas, reporting new infestations and in some cases, working along side spray contractors to achieve desirable results.

X Field days - on specific weeds to demonstrate appropriate or alternative control techniques and there respective effectiveness, eg. Camphor Laurel, Privet, Giant Parramatta Grass.

X Specific purpose meetings to resolve issues, eg public utilities and spread of weeds, eg Telstra/NorthPower and Giant Parramatta Grass.

X Provision of materials, training and technical information with projects which involve Council controlled land.

Dunecare

X Provision of materials, training and technical information with projects which involve Council controlled land eg. Contract spraying or clearing to reduce initial mass of weed infestation, provision of skilled labour, herbicide use training, supply of tools, protective clothing and herbicide.

X Assist with the planning and implementation of specific trials on weed control, eg. Cape ivy herbicide control and flame weeding (propane burning). Assessing benefits of herbicide free control versus composite herbicide/mechanical control, mulching trials etc.

Specific Task Area Conservation Groups

eg. Friends of Kooloonbung Creek Nature Park and Camden Haven Protection Society

X Provision of materials, training and technical information, as above.

X Assistance with funding - submissions eg. Australian Trust for Conservation Volunteers, Coastcare etc.

X Provide assistance with rubbish removal and disposal.

CONCLUSION

Working with Community Groups has proven to be rewarding both personally and for the council, with definite visual and environmental benefits for the region and its communities.

Time is the greatest limiting factor to Council's current range of programs.

The dollar value of works completed is increased through the provision of free labour, free technical advice and access to funding from other areas not usually accessible by Council.

Remember, to maintain the integrity of the group you are working with, they have to have a sense of ownership of the issue or project and your role is not to lead. Facilitate the needs of the group which are set down as your designated tasks, ensure that they remain focused and achieve their measurable milestones within reasonable time, climatic and economic restraints.

NATIVE VEGETATION LEGISLATION - WHY, WHEN, HOW AND IMPLICATIONS FOR NOXIOUS WEED MANAGEMENT

Katrina O'Reilly
Soil and Vegetation Resource Officer - Compliance
Department of Land and Water Conservation Grafton
koreilly@dlwc.nsw.gov.au

notes:

1. This paper does not cover noxious weeds management within the Western Division of New South Wales.
2. The views expressed are not the definitive position of the Department as the interplay between the Native Vegetation Conservation Act 1997 and the Noxious Weeds Act 1993 are currently being reviewed.

BACKGROUND

The retention of vegetation has always been important within New South Wales, however, the reasons for retention have varied. Initially, restrictions on vegetation removal were imposed to ensure land stability however, as time passed, reasons for retention of vegetation diversified.

It is now strongly recognised that retention of vegetation, in particular native vegetation, has an array of positive outcomes that include ecological benefits such as water quality protection, nutrient storage and cycling, habitat characteristics for fauna and flora (in particular threatened species), economic benefits such as maintaining watertable levels, providing shade for stock, reducing moisture loss and various social benefits. To ensure these benefits are maintained and enhanced, the aims and objectives of legislation protecting the destruction or removal of vegetation, have evolved over time and have, in some cases, included non native species such as weeds.

In the early 1800's the government imposed restrictions on vegetation removal within certain riparian zones. Riparian zones have been protected since 1946, originally under the *Water Act 1912*. Then from 1986 until the *Native Vegetation Conservation Act 1997* these provisions were incorporated into the *Soil Conservation Act 1938* as a category of protected land.

In terms of steep lands government policy on 'Protected Land' was 'to accord the highest priority to measures to control pollution and maintain the quality of the environment and, for this purpose, retention of timber on the steepest lands of catchment areas is imperative, in those cases where removal would result in erosion and pollution of our rivers and storage's ... the aim of the provisions is to prevent excessive clearing in the steep valleys on both sides of the Great Divide' (Hansard 1972).

The types of land protected and the values for which it was protected were again enlarged in 1986 to encompass a category 'environmentally sensitive lands'.

PROTECTED LANDS UNDER THE *NATIVE VEGETATION CONSERVATION ACT 1997* (NVC Act)

Protected Land under the *Soil Conservation Act* was subsumed into the NVC Act effective 1 January 1998 (section 4 definition of 'State protected land') being:

- **category 'a':** *Mapped steep land generally over 18 degrees in slope,*
- **category 'b':** *any land that is situated within, or within 20 metres of the bed or bank of any river or lake which is prescribed,* and
- **category 'c':** *Mapped environmentally sensitive land,* such as mass movement areas.

The vegetation to which these provisions apply to is set out in section 5(3):

> (3) For the purposes of subsection (2), ***vegetation on protected land*** means:
> (a) any native vegetation on the protected land, and
> (b) any tree on the protected land (regardless of whether it is dead or alive, standing or fallen, or whether it is indigenous),
> but does not include any type of non-indigenous vegetative groundcover.

The point to note here is that the protected lands provisions extend to non-native trees be they alive or otherwise. Tree being defined to include: 'a sapling or a shrub, or scrub' (section 4 of NVC Act). Further, when incorporated into the NVC Act the protected lands provisions expanded to cover 'native vegetation' as defined in section 6 which includes groundcover and understorey plants (as opposed to just trees under the *Soil Conservation* Act).

STATE ENVIRONMENTAL PLANNING POLICY No. 46 - SEPP 46

In August 1995 State Environmental Planning Policy No. 46 - "Protection and Management of Native Vegetation" (SEPP 46) was introduced. This Environmental Planning Instrument (EPI) under the *Environmental Planning and Assessment Act 1979* (EP&A Act) covered all private land (and some public land including leased Crown Land) except land administered under the *Western Lands Act 1901* and Protected Land under the *Soil Conservation Act.* This policy was only for an interim period and in December 1997 the *Native Vegetation Conservation Act 1997* was passed and came into effect on 1 January 1998.

This Act repealed SEPP 46 and incorporated vegetation clearing controls previously contained in it as well as those in the *Soil Conservation Act* and *Western Land Act.* Many of the definitions, exemptions and exclusions relevant to those Acts and SEPP 46 were incorporated and some amended in the NVC Act (see appendix 6). Protected Land became known as State protected land (SPL) in the NVC Act.

Evolution of the protection and management of native vegetation has resulted in legislation applying over basically the whole landscape (with the significant exception of State Forests and National Parks). However, as the issue of controls on clearing vegetation on private land is dynamic and controversial it may still be in a transitional phase which could lead to further amendments and additions. These changes may occur by provisions within the NVC Act that allow for future direction of native vegetation management through the development of Regional Vegetation Management Plans (as discussed later in this paper).

NVC Act and it's interactions with the Noxious Weeds Act 1993 (NW Act)

The activities that constitute clearing for the purposes on the NVC Act are defined extremely broadly:

5 Definition of "clearing"

(1) In this Act, ***clearing*** native vegetation means any one or more of the following:
  (a) cutting down, felling, thinning, logging or removing native vegetation,
  (b) killing, destroying, poisoning, ringbarking, uprooting or burning native vegetation,
  (c) severing, topping or lopping branches, limbs, stems or trunks of native vegetation,
  (d) substantially damaging or injuring native vegetation in any other way.

(2) In this Act, ***clearing*** protected land means any one or more of the following:
  (a) cutting down, felling, thinning, logging or removing any vegetation on protected land,
  (b) killing, destroying, poisoning, ringbarking, uprooting or burning any vegetation on protected land,
  (c) severing, topping or lopping branches, limbs, stems or trunks of any vegetation on protected land,
  (d) substantially damaging or injuring any vegetation on protected land in any other way.

Under Part 3 Division 1 of the NW Act the onus is on the occupier or owner of the land to control noxious weeds on that part of land, as required under the control category or categories specified in relation to the weeds concerned. Should the occupier fail to control noxious weeds on the property they could incur penalties of up to 40 penalty units.

Thus the inter-relationship between the NVC Act and NW Act is that, if clearing of noxious weeds is authorised under the NW Act ie: clearing in accordance with requirements of control categories W1, W2, W3, W4 (a) to (f) (see appendix 1), it is excluded (in so far as that weed is concerned) from the requirements of the NVC Act (Section 12 (c) exclusion '*any clearing authorised under the Noxious Weeds Act 1993'),* as long as it is carried out by the person given the authority or power under the NW Act and is in accordance with action required of the control category of that particular noxious weed. In addition there is an exemption applicable to only non-State protected lands carried over from SEPP 46 that is wider in its effect than the exclusion under section 12(c).

There are a number of factors that may have impacts on noxious weed management in regard to the NVC Act. These include:

- whether the weed is on land which is excluded from the NVC Act eg: Local Environmental Planning (LEP) zoning's, SEPP (14), SEPP (26), National Park (NP) or State Forest (SF) (see NVC Act sections 9, 10 &11 and Schedule 1)

- whether the proposed clearing of the noxious weed is excluded from the NVC Act under section 12, particularly 12(c) '*any clearing authorised under the Noxious Weeds Act 1993'.*

- whether the land is State Protected Land or land previously covered by SEPP 46.

- whether the proposed activity to remove the weed will result in damage to other vegetation eg: spraying of weeds.

It is easy to establish the status of the land and the category of the weed. This is achieved by;

- contacting council to determine category of the weed proposed to be removed and zoning of the land on which the weed is on; and

- contacting Department of Land and Water Conservation (DLWC) to establish whether the weed is on land gazetted as State Protected Land.

NOXIOUS WEED MANAGEMENT ON NON-STATE PROTECTED LAND

A large portion of land within the eastern and central division of New South Wales is not mapped State protected land ie: not within 20 metres of a prescribed stream, creek or river, less than 18 degrees in slope and not mapped environmentally sensitive land. Clearing of native vegetation proclaimed as a noxious weed on this land is exempt from the need to obtain consent under the NVC Act (NVC Act Schedule 4.3(2) that carries over the exemptions from SEPP 46 Schedule 3 of which exemption (k) is most relevant - see appendix 5). Clearing of non-native species on these areas, including weeds is not covered by the NVC Act.

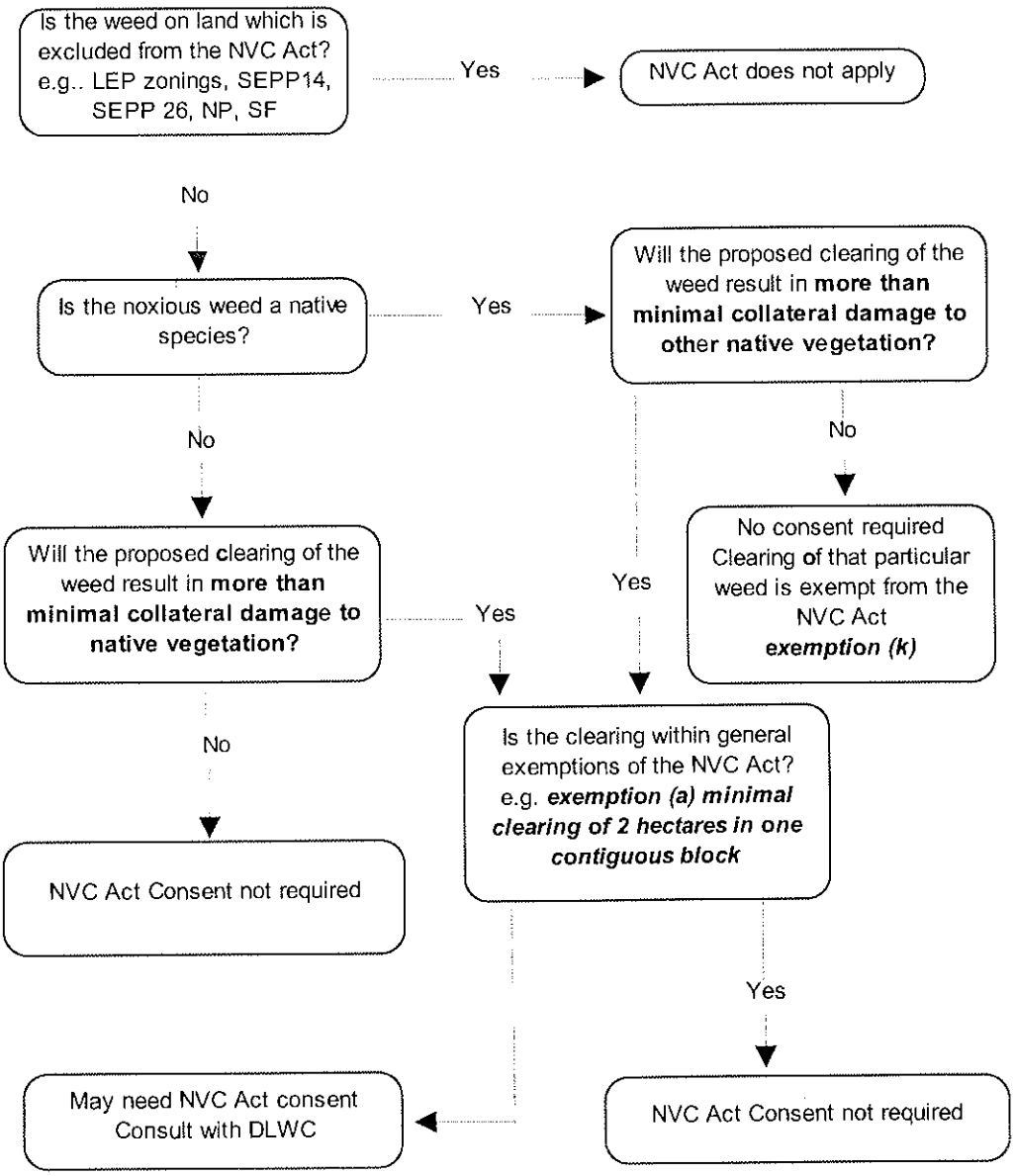
Removal of noxious weeds on non-State protected land should be undertaken in a manner that does not result in clearing of native vegetation as defined other than the noxious weeds in question (see appendix 2 & 3). Should the activity undertaken to remove noxious weeds (eg: spraying) result in more than minimal collateral damage to native vegetation, in particular native groundcover as defined in the definitions (see appendix 3), there are 2 options for the person undertaking the activity:

1: investigate the applicability of other exemptions under the NVC Act eg: *exemption (a)Minimal clearing.* The minimal clearing of up to 2 hectares per annum. This allows the removal of all native vegetation within the 2 hectare area; or

2: apply under the NVC Act assessment process.

Process for removal of noxious weeds on Non State protected land

note: this only applies to the removal of that particular noxious weed



NOXIOUS WEED MANAGEMENT ON STATE PROTECTED LAND

Areas of State protected land (see appendix 4) exist within the State with the majority contained in the North Coast Region.

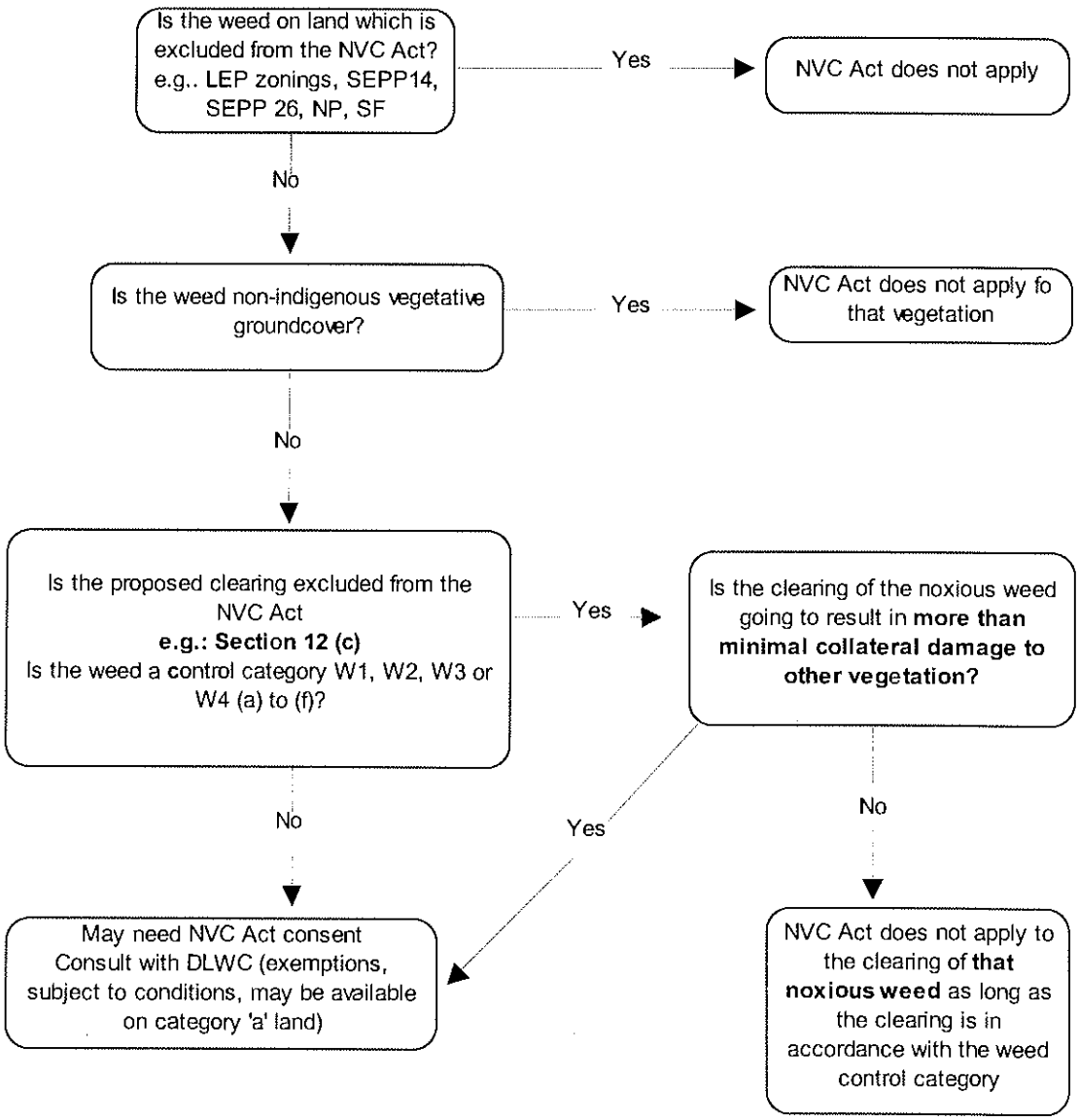
As mentioned earlier management of noxious weeds is excluded from the NVC Act as long as it is undertaken in accordance with the action required of the control category for that particular noxious weed under the NW Act (appendix 1). This exclusion applies to all control categories of noxious weeds eg: W1 to W4 (a) to (f) that require the destruction or suppression of noxious weeds. Although the suppression, management or removal activities required to control that particular noxious weed is excluded from the NVC Act it does not apply to any other vegetation on State

protected land be that native or non-native dead or alive. Hence, if the proposed activity eg; aerial spraying of weeds on category 'a' or 'b' State protected land, is likely to cause more than minimal collateral damage to vegetation covered by the State protected land provisions, other than that particular weed, an application under the NVC Act assessment process would be required.

Two exceptions here are that on category 'a' State protected land there is an area based exemption that permits the destruction of trees (as opposed to native groundcover and understorey plants) on up to 2 hectares (see appendix 6). Further, there is an exemption on all categories of State protected land to permit the destruction of trees that are noxious weeds regardless of the control category requirements provided that it does not result in ground disturbance (see appendix 6).

Process for removal of noxious weeds on State protected land

note: this only applies to the removal of that particular noxious weed



It is stressed that although removal of noxious weeds may occur by an exclusion or exemption under the NVC Act, the Department of Land and Water Conservation has a responsibility under the

Soil Conservation Act to ensure that minimal land degradation occurs as a result of removing the vegetation. Should excessive or unnecessary land degradation occur as a result of the management of noxious weeds, regardless of their control category, remedial measures can be imposed by the Department under a section 15A notice of the Soil Conservation Act 1938 (appendix 8).

FUTURE DIRECTIONS OF NATIVE VEGETATION MANAGEMENT AND ITS IMPLICATIONS ON NOXIOUS WEED MANAGEMENT

Provisions of the NVC Act allow for the development of Regional Vegetation Management Plans (RVMP). These plans will be developed and controlled by Regional Vegetation Committees (RVC) which consist of representatives from rural interests, NSW Farmers, Catchment Management Committee, Landcare Group, Nature Conservation Council, National Parks and Wildlife Service, Local Government, NSW Agriculture, Department of Land and Water Conservation, Aboriginal Land Council and Australian Ecological Society.

Throughout the state many RVC's are currently developing plans and the Mid Lachlan RVMC currently has its draft plan on public exhibition.

From the stated objectives and aims of both the NVC Act and the RVMP, it is not expected that the management of noxious weeds will vary from its current form. The creation of a RVMP may alter the exemptions but not the exclusions. Within some RVMP's certain State protected land areas may be increased and within these areas there may be conditions within the plans to allow a strategic approach to the management of environmental weeds.

TAKE HOME MESSAGES

Generally, the provisions of the NVC Act allow management of noxious weeds, such as destruction and removal, provided minimal collateral damage occurs to other vegetation. However, a few important and essential details need to be remembered:

- on **non-protected land** declared noxious weeds can be cleared without development consent; and

- on **State protected land** declared noxious weeds W1, W2, W3, and all sub categories of W4 can be cleared without development consent under the NVC Act as long as;
    - it is undertaken by the person given the power or obligation to do so under the *Noxious Weeds Act*; and

    - it is cleared in accordance with and/or for the reasons given for the actions specified in the *Noxious Weeds Act* for the appropriate control category; and

    - minimal collateral damage occurs to other vegetation not being non-native groundcover.

- other legislation exists within the state that may protect vegetation, such as Local Environmental Plans, *Threatened Species Conservation Act* and State Environmental Planning Policies. Therefore, should any activity be undertaken that is either excluded or exempt from the NVC Act, relevant administrators of other legislation should be contacted to determine their requirements.

APPENDIX 1: Control categories for noxious weeds as stated in the Noxious Weeds Act 1993.

Section 8 of the *Noxious Weeds Act 1993* provides for various control categories for noxious weeds, including notifiable weeds. The action that is required to be taken (under the *Noxious Weeds Act 1993)* for which a particular control category is specified is set out in section 9 of the Act, as follows:

- For a W 1 noxious weed, the presence of the weed on land must be notified to the local control authority and the weed must be fully and continuously suppressed and destroyed.
- For a W2 noxious weed, the weed must be fully and continuonsly suppressed and destroyed.
- For a W3 noxious weed, the weed must be prevented from spreading and its numbers and distribution reduced.
- For a W4 (a), (b), (c), (d), (e) and (f) noxious weed, the action specified in the declaration must be taken in respect of the weed.

APPENDIX 2: Definitions as stated in the Native Vegetation Conservation Act 1997.

Part 1 Section 5 NVC Act Definition of 'clearing'

In this Act, *clearing* native vegetation means any one or more of the following:

(a) cutting down, felling, thinning, logging or removing native vegetation,
(b) killing, destroying, poisoning, ringbarking, uprooting or burning native vegetation,
(c) severing, topping or lopping branches, limbs, stems or trunks of native vegetation,
(d) substantially damaging or injuring native vegetation in any other way

In this Act, *clearing* protected land means any one or more of the following:

(a) cutting down, felling, thinning, logging or removing any vegetation on protected land,
(b) killing, destroying, poisoning, ringbarking, uprooting or burning any vegetation on protected land,
(c) severing, topping or lopping branches, limbs, stems or trunks of any vegetation on protected land,
(d) substantially damaging or injuring any vegetation on protected land in any other way.

For the purposes of subsection (2), *vegetation on protected land means:*

(a) any native vegetation on the protected land, and
(b) any tree on the protected land (regardless of whether it is dead or alive, standing or fallen, or whether it is indigenous),

but does not include any type of non-indigenous vegetative groundcover.

For the purposes of this Act, ***clearing*** native vegetation, or ***clearing*** protected land, does not include sustainable grazing. Sustainable grazing is the level of grazing that, in the opinion of the Director-General, the vegetation concerned is capable of supporting without resulting in a substantial long-term modification of the structure and composition of the vegetation

APPENDIX 3: Definitions as stated in the Native Vegetation Conservation Act 1997.

Part 1 Section 6 NVC Act Definition of 'native vegetation'

In this Act, native vegetation means any of the following types of indigenous vegetation:

(a) trees,
(b) understorey plants,
(c) groundcover,
(d) plants occurring in a wetland.

For the purposes of this definition, ***groundcover*** means any type of herbaceous vegetation, but it is only to be regarded as native vegetation for the purposes of this Act if it occurs in an area where not less than 50% of the herbaceous vegetation covering the area comprises indigenous species. In determining that percentage, not less than 10% of the area concerned must be covered with herbaceous vegetation (whether dead or alive).

Note: *Subsection (2) takes into account seasonal impacts (such as drought) in determining the amount and type of groundcover occurring in an area.*

For the purposes of this Act, ***native vegetation*** does not include mangroves, seagrasses or any other type of marine vegetation within the meaning of the *Fisheries Management Act 1994.*

APPENDIX 4: Definitions as stated in the Native Vegetation Conservation Act 1997.

Part 1 Section 7 NVC Act State protected land.

(1)The Minister may, by order published in the Gazette, identify:

(a)any land the surface of which generally has a slope greater than 18 degrees from the horizontal, or
(b) any land that is situated within, or within 20 metres, of. the bed or bank of any part of a river or lake specified in the order, or
(c)any land that is, in the opinion of the Minister, environmentally sensitive or affected or liable to be affected by soil erosion, siltation or land degradation,
as State protected land for the purposes of this Act.

(2)Any such order must identify the land concerned in such a manner as the Minister thinks appropriate (whether by the use of a map, land description, or otherwise).

(3)The Minister may, by order published in the Gazette, do any of the following things in relation to State protected land:

(a) revoke the status of the land as State protected land,
(b)alter the identification of the State protected land.

Note. *State protected land* is defined in this Act to include any land previously defined as *protected land* under the *Soil Conservation Act 1938.* An order under subsection (3) therefore will be able to deal with any type of State protected land even though it has not been identified by an order under subsection (1).

(4)Any land that is State protected land ceases to be State protected land if:

(a) the land is identified as regional protected land in accordance with a regional vegetation management plan, or
(b) the land otherwise becomes land to which a regional vegetation management plan applies.

APPENDIX 5: Exemptions from the Native Vegetation Conservation Act 1997 as defined in booklet Definitions and Exemptions State Environmental Planning Policy No. 46 - Protection and Management of Native Vegetation **Amendment No. 2 Department of Land and Water Conservation July 1997.**

Page 20 Exemption (k) ***Noxious Weeds***. The clearing of native vegetation proclaimed as a noxious weed.

This exemption allows land owners to clear native vegetation that is proclaimed as a noxious weed.

Comment

This exemption allows the clearing of noxious weeds, provided the native vegetation is proclaimed as a noxious weed.

In this regard, proclaimed is taken to mean an official listing of the plant species as a noxious weed within the meaning of the *Noxious Weeds Act 1993*. These plant species are declared by an order under section 7 of the *Noxious Weeds Act 1993* to be a noxious weed.

Section 7 also prevents the Minister from making an order declaring any tree, shrub, fern, creeper, vine, palm or plant that is native to the State to be a noxious weed, except with the consent of the Minister administering the *National Parks and Wildlife Act 1974.*

Section 8 of the *Noxious Weeds Act 1993* provides for various control categories for noxious weeds, including notifiable weeds. The action that is required to be taken (under the *Noxious Weeds Act 1993)* for which a particular control category is specified is set out in section 9 of the Act, as follows:

- For a W 1 noxious weed, the presence of the weed on land must be notified to the local control authority and the weed must be fully and continuously suppressed and destroyed.
- For a W2 noxious weed, the weed must be fully and continuously suppressed and destroyed.
- For a W3 noxious weed, the weed must be prevented from spreading and its numbers and distribution reduced.
- For a W4 noxious weed, the action specified in the declaration must be taken in respect of the weed.

There are two circumstances where this exemption may be relevant.

Firstly, the exemption expressly applies where a land owner wishes to clear native vegetation which is a noxious weed within the provisions of the *Noxious Weeds Act 1993.*

Secondly, situations have arisen where non-native vegetation, which is listed under the Gazette as noxious, occurs amongst communities of native vegetation, especially native grassland (and these plants are not listed). Under the circumstances, a land owner may be directed, by a formal Notice, by a local authority to eradicate a noxious weed(s).

In addressing small infestations, if controlled techniques such as spot spraying are used, consent under NVC Act will not be required. Where significant infestations occur and alternative methods such as boom spraying are required, eradication will be allowed without NVC Act development consent provided the clearing is undertaken in a manner that avoids the unnecessary destruction of native vegetation and the land holder does so under a formal Notice under the *Noxious Weeds Act 1993.*

On the advice of National Parks and Wildlife Service, three native plants have been declared noxious weeds, under the following circumstances:

Water lettuce *(Pistia stratioles)* is a W1 declared noxious weed in all Shires.

Galvanised burr *(Sclerolaena birchii)* is declared in the Shires of Balranald, Bland, Bega, Carrathool, Castlereagh County Council (CC), Central Murray CC, Central North CC, Cobar, Corowa, Dubbo, Far North West Slopes CC, Forbes, Griffith, Gunnedah, Hay, Jerilderie, Lachlan, Leeton, Lockhart, Merriwa, MidWestern CC, Moree, Murrumbidgee, Narrabri, Narrandera, Narromine, Parkes, Southern Slopes CC, Temora, Upper Hunter CC, Urana, Wagga Wagga, Wakool, Weddin, Wellington and Wentworth.

Sifton bush *(Cassinia arcuata)* is a W2 declared noxious weed in the Shires of Wingecarribee, Snowy River, Queanbeyan; and a W3 in Cabonne, Crookwell, Goulburn, Southern Slopes Noxious Weed County District, Gunning and Mulwaree.

Be aware that these notifications are subject to change and the local authority should also be consulted.

APPENDIX 6: Exemptions from the Native Vegetation Conservation Act 1997 on State protected land.

Exemption that applies to only category 'a' State protected land.
Which activities are exempt?

- ringbarking, cutting down, felling or poisoning or otherwise destroying any tree
- topping, lopping, removing or injuring any tree
- causing any of the above

Conditions:

Provided that the activity is within any of the following circumstances:
carried out by the owner or occupier of the subject land; and
the trees are on not more than two hectares (2 ha) of each separate area of protected land, if that two hectares is not more than 25% of that separate area of protected land, and only if the activity is not for vehicular track or road construction, or for development of land for plantations, horticulture or crop growing.

NOXIOUS PLANTS EXEMPTION FOR ALL CATEGORIES OF PROTECTED LAND

Which activities are exempt?

- ringbarking, cutting down, felling or poisoning or otherwise destroying any tree
- topping, lopping, removing or injuring any tree
- causing any of the above

Conditions:

Provided that:

(a) the tree is a noxious weed, a notifiable weed or any other type of noxious plant in that part of NSW where the protected land exists, and
(b) the activity does not involve disturbance of the soil and
(c) the person is required or authorised under any Act to remove weeds.

APPENDIX 7: Exclusions from the Native Vegetation Conservation Act 1997 as stated in the Act.

For both State protected land and non-protected land an exclusion from the NVC Act applies for noxious weed management:

Part 1 Section 12: Clearing excluded from operations of Act. This act does not apply to the following types of clearing:

(c) Any clearing authorised under the *Noxious Weeds Act 1993.*

APPENDIX 8: Soil Conservation Act 1938 Section 15 A. Issue of notices.

15A

(1) If the commissioner is of the opinion that:
(a) any act or thing done or proposed to be done on or in relation to any land; or
(b) the failure to do any act or thing on or in relation to any land,

has caused or is likely to cause soil erosion or land degradation on that land or on other land and that the erosion or degradation or its effects can be mitigated or avoided, the Commissioner may by notice served personally or by post on the owner or occupier of, or on the holder or grantee of any timber rights over, the first mentioned land require that owner, occupier, holder or grantee, within the time specified in the notice, to:

(c) abstain from doing; or
(d) do or permit to be done,
such acts and things as may be specified in the notice.

(2) A notice under this section does not have any effect in respect of land while a notice under Section 18 or 22 is in force in respect of that land.

(3) Notices may , in relation to the same area of land, be served on one or more of the persons referred to in subsection (1).

(4) A notice may be revoked, varied or amended by a like notice.

WHAT'S NEW IN WOODY WEED CONTROL FROM DOW ?

Christopher Love
Development Manager - Herbicides
Dow AgroSciences Australia Ltd., Brisbane

INTRODUCTION

Dow AgroSciences (formerly DowElanco), a major manufacturer of woody weed herbicides, have a number a new label claims for Grazon* DS Herbicide, Garlon* 600 Herbicide and Graslan* Herbicide approved for 1999. New registrations for Starane* 200 Herbicide and Tordon* Timber Control Herbicide are likely to be approved in the latter part of 1999.

The purpose of this paper is to communicate the label changes to the Noxious Weeds Inspectors in New South Wales plus others who are making recommendations on woody weed control.

LABEL UPDATES

Grazon DS (100 g/L picloram as hexyloxypropylamine salt + 300 g/L triclopyr as butoxyethyl ester)

Some major changes have been made to the label in the latest update (NRA Approval No. 31558/1098). The new weeds added to the label are shown in Tables 1 and 2 below.

Table 1. New Claims for the High Volume Application Section of the Grazon DS label.

Weed	**Use Rate (mL/100L water)**
Horehound Japanese sunflower Mesquite Siam weed (Qld only)	350
Lantana montevidensis Smartweed	350 - 500
Blue heliotrope Mother-of-millions Paddy's lucerne Prickly pear Smooth tree pear (common)	500

Table 2. New Claims for Boom Application in Pastures for the Grazon DS label.

Weed	**Use Rate (L/ha)**
St John's wort	2 to 4

A compatibility section has also been included on the new label. Products which are compatible with Grazon DS are 2,4-D amine, metsulfuron-methyl and Roundup# CT.

* Registered Trademark of Dow AgroSciences
# Registered Trademark

The addition of adjuvants to Grazon DS for more reliable control of lantana (*Lantana camara*) have also been included on the label. The adjuvants which should be added to the 350 mL/100L use rate are Uptake* Spraying Oil @ 0.5% v/v and Pulse# Penetrant @ 0.1% v/v, as shown in Figure 1.

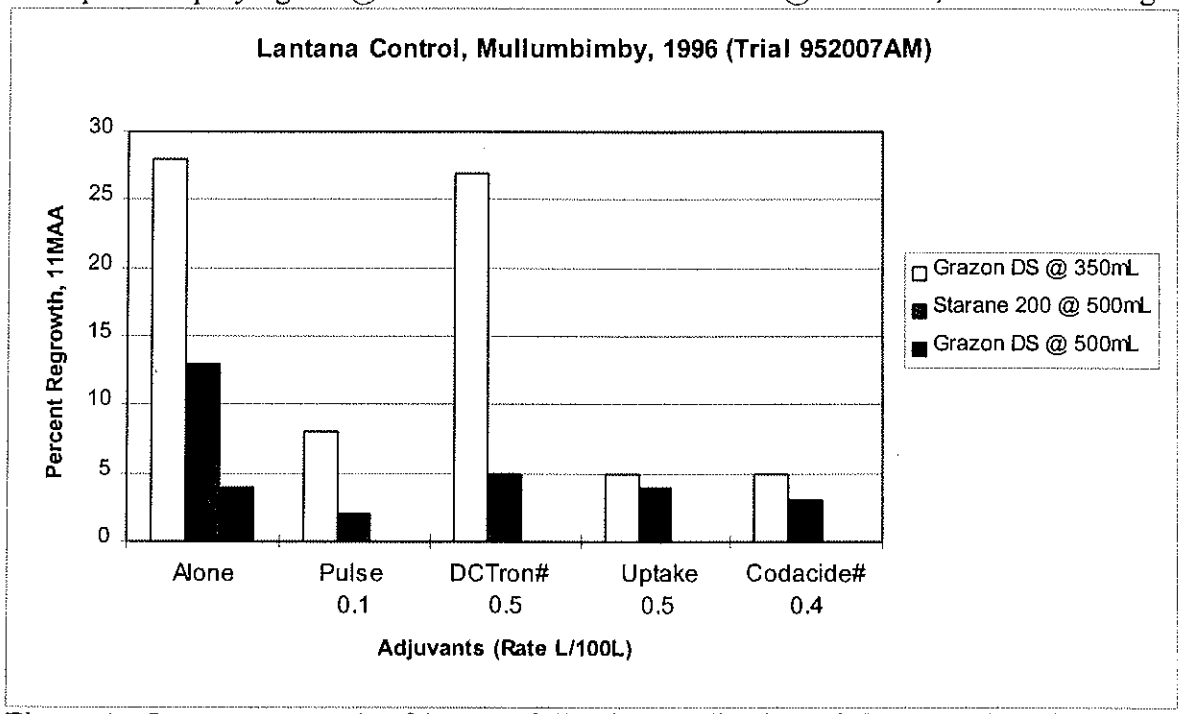


Figure 1. Percent regrowth of lantana following application of Grazon DS and Starane 200 with different adjuvants, Mullumbimby, 1996.

Garlon 600 (600 g/L triclopyr as butoxyethyl ester)

Only minor changes have been made to this label (NRA Approval No. 31898/0199), although the weeds are now in alphabetical order plus it is a more user friendly label to read. The new weeds to be added to the label for NSW are shown in Table 3 below.

Table 3. New Claims for Basal Bark Application in Pastures for the Garlon 600 label.

Weed	Use Rate (L/60L diesel)
Broadleaf hopbush Narrowleaf hopbush Turpentine bush	1

The use of Garlon 600 tankmixed with Roundup CT for the control of melons in fallow is now registered for aerial application, with the observance of a buffer zone of 150 metres to protect native trees.

Garlon 600 is also now registered in sorghum for the control of prickly paddy melon (*Cucumis myriocarpus*) at a rate of 80 mL/ha. This rate can be mixed with Starane 200 and atrazine (500 g/L) for increased weed spectrum. DO NOT add crop oils, as crop damage may occur.

Registered Trademark

Graslan (200 g/kg tebuthiuron)

The new 10kg (hand application) and 25kg (aerial application) labels for Graslan (NRA Approval No. 41257/1298) have been synchronized compared to the previous labels.

The 10kg label, for hand application only, has control of blue heliotrope at the rate of 0.5 g/m^2. There are no other changes which relate to NSW.

PROPOSED LABEL UPDATES

Starane 200 (200 g/L fluroxypyr as methylheptyl ester)

The draft label for additions to the Starane 200 label were submitted in October, 1998. We expect a positive outcome from the NRA (National Registration Authority) in late 1999.

The proposed weeds to be added to the label for NSW are shown in Tables 4, 5 and 6 below.

Table 4. Proposed Claims for the High Volume Application Section of the Starane 200 label.

Weed	Use Rate (mL/100L water)
Bathurst burr Noogoora burr	75
Blackberry nightshade Broadleaf pepper tree Cockspur thorn Creeping lantana Docks Flannel weed Hexham scent Small flowered mallow	500
Mother-of-millions	600
Blue heliotrope	1000
Wandering jew	1500

Table 5. Proposed Claims for Boom Application in Pastures for the Starane 200 label.

Weed	Use Rate (L/ha)
Silverleaf nightshade	0.75 + Uptake
St John's wort	3

Table 6. Proposed Claims for Basal Bark/Cut Stump Application for the Starane 200 label.

Weed	Use Rate (L/100L diesel)
Honey locust - up to 10cm	1.5
Honey locust - up to 20cm	3.0
Honey locust - >20 cm	5.0
Chinese celtis	3.5
Cockspur thorn	2.0

Tordon TCH (50 g/L picloram as triisopropanolamine salt + 100 g/L triclopyr as triethylamine)

The draft label for changes to the Tordon TCH label were submitted in March, 1999. We expect a positive outcome from the NRA in November, 1999. As part of the changes, a double strength formulation of Tordon TCH is also being pursued.

The proposed weeds to be added to the label for NSW are shown in Tables 7, 8 and 9 below.

Table 7. Proposed Claims for Stem Injection Application for the Tordon TCH label.

Weed	Dilution
Camphor laurel *Melaluca* species	1 : 1.5

Table 8. Proposed Claims for Cut Stump Application for the Tordon TCH label.

Weed	Dilution
Angophora species *Acacia* species *Casuarina* species *Eucalyptus* species *Lophostemon* species	1 : 10

Table 9. Proposed Claims for High Volume Application for the Tordon TCH label.

Weed	Use Rate (L/100L water)
Harrisa cactus (Qld only)	5
Blackberry	1

For blackberry, the proposed label rate requires the addition of an adjuvant. As shown in Table 10, the addition of Uptake Spraying Oil, Hasten# or Supercharge# improved the reliability of Tordon TCH for the control of blackberry.

Table 10. Effect of the Addition of Different Adjuvants to Tordon TCH for the Control of Blackberry, 12 MAA, Compared to the Standard, Grazon DS, Eastern Australia, 1996-98.

Tordon TCH @ 1L/100L water		Percent Control, 12 MAA
Adjnvant	Rate (mL/100L water)	Mean of 8 blackberry sites [ ] = range of values
None	-	92 [73-100]
Uptake	500	96 [85-100]
BS-1000	100	92 [81-100]
Pulse	100	91 [73-100]
Hasten	500	96 [83-100]
Supercharge	500	96 [90-100]
Grazon DS (standard)	500	96 [88-100]

Registered Trademark

FUTURE LABEL REVIEWS

Access* Herbicide (120 g/L picloram as isooctyl ester + 240 g/L triclopyr as butoxyethyl ester)

Access, mixed with diesel, provides effective control of problem woody weeds by basal bark application. Numerous weeds, shown in Table 11, are currently not on the Access label and are to be included in the proposed label submission, which is currently underway.

Table 11. Proposed Claims for Basal Bark/Cut Stump Application for the Access label.

Weed	Use Rate (L/60L diesel)
African boxthorn Broadleaf privet Mesquite *Corymbia* species Green cestrum Mimosa bush Cockspur thorn Snake cactus Whitewood Tree-of-Heaven	1
Bitterbark (cut stump only) Guava Corkwood wattle	2

Lontrel* Herbicide (300 g/L clopyralid as triisopropanolamine salt)

Lontrel, up to rates of 2 L/ha, is selective to many species of Eucalypts and is currently being evaluated for broadleaf weed control in Eucalypt plantations. As well, pre-emergent control of *Acacia* spp. in pine plantations is being evaluated at present.

Another project is looking at the control of root suckering wattles by stem injection with Lontrel. Some promising results are being shown with Lontrel at 1:4 with water as a stem injection technique compared to Tordon TCH at 1:1.5.

TAKE HOME MESSAGES

- Grazon DS, Garlon 600 and Graslan have new registered labels, which are available at the conference in the Dow AgroSciences Product Guide.
- Starane 200 and Tordon TCH have new label updates pending registration by NRA.
- The Access and Lontrel labels are in the process of being updated.

Dow AgroSciences has an updated Woody Weed Herbicide Application Techniques Video available which shows the best method to apply the above products.

ENVIRONMENTAL WEEDS AND THEIR CONTROL
With Particular Reference To Rainforest Remnant Restoration

Rosemary Joseph (R. Joseph Consulting Pty. Ltd.)
Rainforest Restoration Consultant
Supervising Regenerator (NSW National Parks & Wildlife Service, Lismore City Council & Tweed City Council)
Teacher in Bushland Regeneration, T.A.F.E.

INTRODUCTION

What is a weed? The commonly accepted definition *viz.* "a plant growing where it is not wanted" is very broad and as such is open to a vast array of subjective interpretations. Nevertheless, weeds are generally classified as agricultural and noxious weeds, garden and landscaping weeds, and environmental weeds.

Environmental weeds are plants that readily invade native vegetation, almost always adversely affecting the regeneration and survival of the indigenous flora and fauna (Rawling 1994). They can be plants of overseas origin, such as Madeira Vine (*Anredera cordifolia*) from South America, or plants native to other parts of Australia, such as Queensland's Umbrella Tree (*Schefflera actinophylla*), which is now a significant pest in littoral rainforests and other rainforest types in northern NSW Even plants which are native to the same geographic area but which are growing out of their natural habitat can become environmental weeds. An example is Fishbone Fern (*Nephrolepis cordifolia*) which grows naturally among rocks in rainforests in highland areas of northern NSW (Jones 1976, 174-175); because it is extremely hardy and adaptable to most situations, it is frequently cultivated. It too has become a serious weed in littoral rainforests, mainly as a result of garden dumpings and through wind- and water-dispersal of spores.

Environmental weeds harm native vegetation because:

- they compete with native species for sunlight, nutrient, moisture and space, and so reduce the numbers and diversity of native species by displacing them;
- they repress the juvenile plants of the canopy species and inhibit the germination of other native species, so preventing the natural regeneration processes from occurring;
- they change the food sources and habitats available to wildlife and so can change the wildlife populations;
- weed vines can destroy the canopy trees, and thus create favourable conditions for further weed invasion; and
- they may harbour undesirable pests and diseases (Buchanan, 1990).

There are many significant environmental weeds on the Far North Coast of NSW **Table 1** provides a list of species which occur frequently in local rainforest remnants; subtropical, dry and littoral. It should be noted that this list is by no means exhaustive. New weeds are introduced into native vegetation by dumpings of garden refuse, and the constant search for the "wonder" fruit crop for the north coast regularly sees new bird-dispersed weeds such as Coffee, White Sapote, Olives and Brazilian Cherry invading nearby rainforest remnants.

RAINFORESTS

Rainforest in NSW can be divided into four main structural types or subforms (Williams, Harden & McDonald 1984, 4-5) *viz.* :

1. *subtropical rainforest*
2. *dry rainforest*
3. *warm-temperate rainforest*
4. *cool-temperate rainforest*

Rainforest remnants on the Far North Coast of NSW belong to the subtropical and dry rainforest types (including several remnants of littoral rainforest - according to Floyd (1990a, 4) littoral rainforest is not usually considered a separate subform but is derived mainly from the subtropical subformation and includes representatives of the dry rainforest subformation. It generally has the ability to withstand high levels of airborne salt).

According to Floyd (1990a, 3-4), rainforest possesses a closed canopy of trees which excludes at least 70% of the sky when viewed from below. Subtropical rainforest is characterised by two to three strata of trees forming the canopy (although Floyd states that these layers are not immediately obvious as species in the upper layer must progress through the lower layers) and a ground layer consisting of large-leaved herbs and ferns.

Dry rainforest, on the other hand, has two tree strata which form the canopy, a dense layer and an upper layer consisting of scattered emergent trees such as Hoop Pines, a well-developed, prickly shrub layer and sparse herbaceous ground cover (Floyd 1990a, 4).

Ongoing regeneration of the rainforest is a complex and continuous process and (at any one time) a forest is a mosaic of patches at different stages of growth and maturity (Adams 1994, 103).

RAINFOREST REMNANTS

Remnants are small sections of vegetation left over after the main portion has disappeared. The small size, abrupt edges, large edge to area ratio and isolation of these remnants make them extremely vulnerable to damage, particularly by weeds, which can alter not only the structure of the forest but also the species composition (Date & Recher 1988, 26). If weeds gain control and dominate a regenerating area, the process of regeneration can be delayed or even halted (Floyd 1988, 24).

Environmental weeds in rainforest remnants

The effects of weeds on the regenerating rainforest differ according to their life form and growth habit. It is the opinion of the author that weed vines are the greatest problem for rainforest remnants as they can very rapidly destroy the structure of the forest. According to Floyd (1988, 25), exotic vines can smother all stages of the forest succession and regeneration in these remnants for an indefinite period.

Growth of weed vines is usually rampant in gaps in the forest canopy and on the edges of the remnant, where they smother the surrounding canopy trees reducing their ability to photosynthesize. The sheer weight of some vines such as Madeira Vine, can break limbs and eventually kill the trees. The forest canopy is further destroyed as many trees are reduced to vine-covered poles. This destruction of the canopy creates conditions suitable for more weed invasion.

Some of the most damaging vines are Madeira Vine (*Anredera cordifolia*), Balloon Vine (*Cardiospermum grandiflorum*), Cat's Claw Creeper (*Macfadyena unguis-cati*), Climbing

Asparagus (*Protasparagus plumosus*), Asparagus Fern (*P. africanus*) and the various species of Morning Glory (*Ipomoea* spp.). By far the worst weed, in terms of both ecological and economic impact, is Madeira Vine.

Introduced trees displace and can eventually replace native species in the canopy; a significant proportion of the canopy of some rainforest remnants is now comprised of such weeds as Large-leaved Privet (*Ligustrum lucidum*) or Chinese Celtis (*Celtis sinensis*). Shrubs such as Lantana (*Lantana camara*), Ochna (*Ochna serrulata*) and Bitou Bush (*Chrysanthemoides monilifera* ssp. *rotundata*) can quickly dominate the middle forest layer, outcompeting and displacing native shrubs. Growth of emerging canopy species is also hindered.

Groundcover weeds not only inhibit the germination of native species, but damage existing young native plants by smothering them, often leading to their death. Species such as Hairy Commelina (*Commelina benghalensis*), Ground Asparagus (*Protasparagus aethiopicus*), various exotic grasses such as Broad-leaved Paspalum (*Paspalum wettsteinii*) and Wandering Jew (*Tradescantia fluminensis*) are a serious problem in and around rainforest remnants.

Wandering Jew, for example, is extremely shade-tolerant and can form a ground cover up to 60 centimetres in depth, particularly in alluvial rainforest areas. This can cause many environmental changes to the floor of the forest, such as a reduction in light levels and soil temperature and an increase in soil moisture levels; these factors may inhibit the germination of seeds in the soil-bank and interfere with nutrient cycling by interrupting litter decomposition. Although most tree species have large to moderately large seeds whose emerging root can penetrate the leaf litter layer on the forest floor to reach the mineral soil (Floyd 1990a, 67), the dense, deep infestations of Wandering Jew in many rainforest remnants may prevent all but the heaviest fruits and seeds from reaching the soil beneath. Many species with smaller fruits and seeds may be disfavoured and the build-up of these seeds in the soil may thus be impeded. A viable soil seed-bank plays a vital role in secondary succession in rainforests.

The eventual outcome of this scenario is the "short-circuiting" of the natural processes of regeneration and succession. In some rainforest remnants the native upper canopy may appear healthy and intact, but the forest is, in fact, in decline as fewer and fewer young native plants germinate and grow to replace senescing canopy trees.

PRIMARY AIM OF RAINFOREST REGENERATION

The primary aim in rainforest restoration (based on a definition of ecological restoration from the American Society for Ecological Restoration, 1993) is "to restore, to the extent possible, the structure, the function, the integrity and the dynamics of the pre-existing vegetation and the sustaining habitat that it provided."

Restoration of native plant communities is a complex, long-term process. Weed control is only one aspect of restoration but it is of paramount importance. All weeds must be seen as part of a dynamic, interacting ecosystem and must be managed and controlled in such a way that *they are replaced by native species rather than by other weeds.*

This is the fundamental difference between weed control for restoration purposes and weed control *per se.*

HOW CAN WEEDS BE REPLACED BY NATIVE SPECIES?

(a) by careful use of "resources"

There are five main factors which are necessary for plant growth: *light, water, air, nutrients* and *temperature* (appropriate for the particular species). A plant also requires *space* (in which to grow). It is useful to think of light, water, air, nutrients and space as *resources* which all plants use in different amounts. For example, a large Privet Tree in a rainforest remnant requires a greater amount of all the resources than does a small rainforest shrub growing nearby. If the Privet is removed, firstly by chainsawing it down, and then killing it by poisoning the stump, all the resources which it was using, but in particular light and space, will suddenly become available to other plants. In this case, it will probably be the Privet seedlings, formerly suppressed by the parent tree but now released, which will reach for the sky. If, on the other hand, the Privet was stem-injected with herbicide and left standing, resources are only gradually made available, Privet seedlings will be "released" more gradually and the natives will have a much better chance to reclaim the site.

(b) by exploiting the natural regeneration capacity of the native vegetation and using the appropriate weed control technique

Native plant communities have many strategies to recover after a natural disturbance, such as a cyclone or a treefall in the rainforest. For example, the dormant seeds of many rainforest plants are stored in the soil, sometimes for many years. It takes only a small increase in temperature, such as the sunlight reaching the forest floor after a large treefall, to stimulate their germination (Floyd 1990a, 66-67). In some situations, removal of dense weed groundcovers by herbicide spraying is sufficient to allow light to reach the soil and thus to stimulate germination of the stored seed. However, in other situations such as very large gaps in the forest or around its edges, it may be necessary to deliberately disturb the soil to stimulate germination's of native seeds. This may be achieved simply by handpulling some weeds instead of spraying *in situ*. However, in cases of severe soil compaction with little or no native regeneration (such as is often the case on ex-grazing land around a remnant) soil disturbance can be created by lightly ripping the soil with machinery or by using machinery to pull out weeds such as Lantana.

The seeds of other rainforest species are not stored in the soil but germinate soon after falling to the forest floor. These seedlings can establish and persist in the shade for prolonged periods and will begin to grow when more light becomes available, for example following a tree fall (Adam 1994, 104). Killing a large weed tree by stem-injection of herbicide will create similar conditions suitable for these seedlings to grow.

Seeds are transported into and within the forest by wind, water, birds, Flying Foxes and other animals. It is important to maintain weed-free conditions on the ground to reduce competition and allow the rainforest seeds to germinate. Spraying of dense swards of grass on the forest edge will allow wind-dispersed seeds such as Cudgerie (*Flindersia schottiana*) to germinate. Dropping of bird-dispersed seeds can be encouraged simply by stem-injecting a large weed tree, such as Camphor Laurel (*Cinnamomum camphora*) or Privet (*Ligustrum lucidum*) with herbicide and leaving it standing thus creating a bird-perching site (this also avoids the damage to nearby native vegetation if the tree were felled). Of course, weed species will also regenerate, but with appropriate follow-up maintenance, the balance will be tipped in favour of the rainforest species.

Many rainforest species are capable of vigorous regeneration from coppice shoots and suckers after damage (Floyd 1990a, 68). By deliberately lightly bruising the roots of species known to sucker *e.g.* Brush Ironbark (*Bridelia exaltata*), Giant Stinger (*Dendrocnide excelsa*) and Cheese Tree

(*Glochidion ferdinandi*), rapid closure of a gap can be encouraged and the natives can outcompete the weeds.

The complexities in determining the "right" weed control method can be illustrated by using the common weed Lantana as an example. Where large clumps of Lantana are growing in open grassland surrounding the rainforest remnant, it may be appropriate to rip it out of the ground with machinery, but this is hardly a feasible option in a gap within a rainforest remnant. In this situation, it may be appropriate to knock down the Lantana with a brush hook and spray any regrowth with herbicide. However, if wallabies are present, it may be better to overspray Lantana with herbicide and leave the dead bushes intact to protect emerging native seedlings from predation. These dead bushes may also be useful as habitat for some birds. Where Lantana is not very dense, it may be pulled out of the ground manually, but if erosion is a potential problem, it is more suitable to cut down the plant and paint the stump with herbicide, thereby causing less soil disturbance (Joseph 1999).

Before deciding on the most appropriate weed control technique for a given site it is important that a careful site analysis be carried out. This will include many aspects, but the most important one is to consider the different ways in which the native vegetation will return to the site *i.e.* how will it regenerate? In other words, it is vital to assess and capacity of the native vegetation and link this with weed removal techniques. The choice of weed control method will therefore vary from site to site, and indeed from area to area within the one site in order to achieve effective and sustainable native regeneration. Hence, there is no single "best" way to control a particular weed species.

The most important questions therefore are "what methods can be used to control or remove the weeds?" and "which method(s) will help to achieve native regeneration?"

WEED ERADICATION *versus* WEED CONTROL

Aiming to completely eradicate weeds from rainforest remnants is unrealistic. Weeds will always invade through dispersal by birds, flying foxes and other animals, wind, water and humans. The emphasis therefore needs to be more on weed control rather than eradication.

In achieving such control, it is necessary to strive for cost-efficiency in economic terms and cost-effectiveness in ecological terms. It is therefore important to consider such factors as:
What weeds are here? Where are the weeds? Are they directly damaging the native plants? Are they preventing native plants from regenerating?

A particularly important question is "should some weeds be left untreated or even encouraged?" Are they, in fact, helping native plants to regenerate eg. does Wild Tobacco (*Solanum mauritianum)*, a pioneer plant, aid the establishment of later stage rainforest plants?_Do annuals, such as Farmers Friend (*Bidens pilosa*) or Paddy's Lucerne (*Sida rhombifolia*), help break up compacted soils and provide organic matter? Does the thick band of Bitou Bush on the seaward side of the littoral rainforest, protect the native plants from salt burn, wind damage *etc.*?

Because weed eradication is virtually impossible, a further vital consideration is "—what level of weed infestation can be left?" In many situations partial weed control, if well managed is sufficient to enable adequate native regeneration to take place and "tip the balance" in favour of the native plants.

MANAGEMENT APPROACH

Many restoration projects are unfortunately approached as mere exercises in weed control, with priorities being set on a species by species basis, and individual species such as Bitou Bush selectively targeted. If weed control is carried out in isolation from other ecological considerations, it usually leads to increased re-infestation or to the replacement of targeted weed species with others, some of which may be even more damaging *e.g.* site domination by Glory Lily (*Gloriosa superba*) or Ground Asparagus following removal of Bitou Bush. (It should be noted that target weeding **is** appropriate, however, in regeneration programs where **early control** of a **minor** infestation of a potentially damaging weed species is required, *e.g.* small outbreaks of Climbing Asparagus or Madeira Vine) (Joseph 1999).

It has been the author's experience that weed control, if it is to be truly effective in the long term must be implemented in an orderly and systematic fashion. This is in contrast to the *ad hoc* approach which is often adopted in regeneration projects where work proceeds concurrently in a number of isolated areas or specific weed infestations (Joseph 1999). Where the surrounding forest is weed-infested (as is usually the case), areas treated in this *ad hoc* fashion soon become re-infested. Native plant regeneration is thereby disadvantaged, more follow-up maintenance is required and the forest is very likely to revert to weeds once current work ceases.

By contrast, a systematic approach can be adopted, based on the demarcation of manageable work zones which are individually worked but progressively integrated within an overall regeneration program for the site. Choice of boundaries for work zones is usually based on such features as walking tracks, creeks, drainage lines, distinct vegetation changes such as from the forest edge to grass, *etc.* The author's own field work experience has demonstrated that this approach achieves progressive consolidation and thus more effective and sustainable native regeneration.

CASE STUDY

Moore Park Nature Reserve, Old Grevillea, NSW

Moore Park Nature Reserve is nine hectares in size and is situated at the junction of Findon Creek and the Richmond River, near the village of Old Grevillea in northern NSW It comprises two vegetation types *viz.* open woodland dominated by River Oak (*Casuarina cunninghamiana*), Weeping Bottlebrush (*Callistemon viminalis*) and Black Teatree (*Melaleuca bracteata*), and riverine rainforest of the *Castanospermum - Waterhousea floribunda* alliance and *Castanospermum - Grevillea robusta* suballiance (Floyd 1990b, 83). The rainforest occupies approximately two-thirds of the site and is surrounded for the most part by cleared agricultural land. It has suffered from floods, droughts, clearing and slashing of the native undergrowth, influx of huge numbers of Flying Foxes and severe weed infestation. Weed species are numerous, but the main weeds are: Balloon Vine (*Cardiospermum grandiflorum*), Chinese Celtis (*Celtis sinensis*), Madeira Vine (*Anredera cordifolia*), Moth Vine (*Araujia sericiflora*), Small-leaved Privet (*Ligustrum sinense*) and Wandering Jew (*Tradescantia fluminensis*).

Prior to 1989, Balloon Vine covered the upper canopy and the newly-emerging mid-layer of the rainforest (following cessation of undergrowth slashing) like a giant circus tent (A. Moy, pers. comm., July 1995). The combination of dense weed vine cover and the huge numbers of Flying Foxes which visited annually, eventually caused the decline in health of numerous mature canopy trees. In addition, a thick cover of Wandering Jew on the forest floor prevented germinations of native seeds and inhibited the growth of the few saplings which were present. Madeira Vine, Balloon Vine (and some native vines) and exotic grasses formed a restrictive barrier to expansion at the forest edge (Joseph 1995).

Weed control commenced in 1989 and focused on freeing the canopy and mid-layers from the smothering vines. Control of Wandering Jew on the forest floor was not attempted at this stage. Several subsequent regeneration projects continued to focus on the control of vine weeds with some *ad hoc* attempts to control Wandering Jew. Unfortunately the programs were generally of short duration (six months) and their discontinuous nature, combined with high weed growth rates, meant that it was impossible to adequately maintain the site. By 1996, the groundcover of Wandering Jew was extremely dense and deep, up to 50 centimetres in some areas. At that time, funding for regeneration became more reliable, and input although still relatively low, is now carried out on a regular basis by a team of three regenerators working 18-20 days per year.

Seed dispersal by Flying Foxes is an important component of the ongoing survival mechanisms for rainforests in Australia, as they disperse an immense number of rainforest seeds (Eby 1990, 30). In the past, at Moore Park this annual influx of valuable rainforest seeds was largely wasted as the deep layer of Wandering Jew which covered the forest floor inhibited their germination. Although the native canopy and midlayers had benefited from the previous removal of weed vines some years earlier, the opportunities for more native plants to germinate and grow was still severely limited.

It was thus decided to "work with the Flying Foxes". The site was divided into small manageable work zones and spraying of Wandering Jew was progressively undertaken each year in late autumn - winter, after the Flying Foxes had departed to warmer climates. The aim was to create weed-free areas on the forest floor, ready to receive seeds when the Flying Foxes returned in late spring - early summer. The experience was that, while many weed seeds such as Chinese Celtis (*Celtis sinensis*), Mulberry (*Morus* sp.) and White Sapote (*Casimiroa edulis*) were brought into the forest, native rainforest species also germinated in abundance *e.g.* Bleeding Heart (*Omalanthus populifolius*), Brown Pine (*Podocarpus elatus*), Giant Stinger (*Dendrocnide excelsa*), Guioa (*Guioa semiglauca*), Native Elm (*Aphananthe philippinensis*), Pepperberry (*Cryptocarya obovata*), Poison Peach (*Trema aspera*), Sandpaper Fig (*Ficus coronata*), White Nettle (*Pipturus argenteus*) and many more. Of course, Flying Foxes have not been solely responsible for seed dispersal; birds also continue to disperse the seeds into and within the rainforest. The important result has been that the removal of the Wandering Jew has provided conditions suitable for the germination and growth of seeds, whatever the vector.

The regular presence of thousands of Flying Foxes with their young throughout summer (which coincides with rapid growth rates of weeds), means that weed maintenance at that time is difficult and disturbance of this nursery site is undesirable. While the Flying Foxes are in residence weeds invariably regrow and new ones establish. Thus a round of weed control is scheduled to commence as soon as the Flying Foxes depart so that the site will once again be ready to receive the next year's seed importation!

TAKE HOME MESSAGES

1. Environmental weeds are plants that readily invade native vegetation, almost always adversely affecting the regeneration and survival of the indigenous flora and fauna.
2. The primary aim in restoration of native plant communities is "to restore, to the extent possible, the *structure*, the *function*, the *integrity* and the *dynamics* of the pre-existing vegetation and the sustaining habitat that it provided."
3. Restoration of native plant communities is a complex, long-term process and all weeds must be seen as part of a dynamic, interacting ecosystem.
4. Weeds must be managed and controlled in such a way that *they are replaced by native species rather than by other weeds.*

5. Selectively targeting individual weed species usually leads to increased re-infestation or to the replacement of targeted weed species with others, some of which may be more damaging.
6. Target weeding is appropriate in regeneration programs where early control of a minor infestation of a potentially damaging weed species is required, *e.g.* small outbreaks of Climbing Asparagus or Madeira Vine.
7. It is unrealistic to aim at complete eradication of environmental weeds from remnant vegetation. In fact some weeds may even help in the regeneration process!
8. There is no single "best" way to control a particular weed species. It will vary from site to site and even within the site.
9. Careful site assessment is vital in order to determine the most appropriate weed control technique.
10. A planned, orderly and systematic approach to field work is more successful than an *ad hoc* approach.
11. Successful native plant restoration and weed control depend upon ongoing follow-up weed control and maintenance.
12. It is important to work with the natural regeneration capacity of the forest - it will save time and money and be more sustainable in the long term.

Table 1: COMMON ENVIRONMENTAL WEEDS IN RAINFOREST REMNANTS OF THE FAR NORTH COAST OF NSW

Trees & Shrubs	
Baccharis halimifolia	Groundsel Bush
Celtis sinensis	Chinese Celtis
Chrysanthemoides monilifera ssp. *rotundata*	Bitou Bush
Cinnamomum camphora	Camphor Laurel
Citrus limonia	Bush Lemon
Coffea arabica	Coffee
Eriobotrya japonica	Loquat
Erythrina x *sykesii*	Coral Tree
Eugenia uniflora	Brazilian Cherry
Lantana camara	Lantana
Ligustrum lucidum	Large-leaved Privet
L. sinense	Small-leaved Privet
Morus sp.	Mulberry
Murraya paniculata	Orange Jessamine
Ochna serrulata	Ochna
Psidium guajava	Guava
Ricinus communis	Castor Oil Plant
Schefflera actinophylla	Umbrella Tree
Senna pendula var. *glabrata*	Winter Senna
S. x *floribunda*	Smooth Senna
Solanum mauritianum	Wild Tobacco
Syagrus romanzoffianum	Cocos Palm
Vines & Scramblers	
Acetosa sagittata	Turkey Rhubarb
Araujia sericiflora	Moth Vine

Aristolochia elegans	Dutchman's Pipe
Cardiospermum grandiflorum	Balloon Vine
Caesalpinea decapetala	Thorny Poinciana
Delairea odorata	Cape Ivy
Dioscorea bulbifera	Potato Plant
Gloriosa superba	Glory Lily
Ipomoea alba	Moon Flower
Ipomoea cairica	Coastal Morning Glory
Ipomoea indica	Common Morning Glory
Lantana camara	Lantana
Lonicera japonica	Honeysuckle
Macfadyena unguis-cati	Cat's Claw
Passiflora edulis	Common Passionfruit
P. foetida var. *hispida*	Stinking Passionflower
P. suberosa	Corky Passionfruit
P. subpeltata	White Passionflower
Protasparagus africanus	Asparagus Fern
P. plumosus	Climbing Asparagus
Solanum seaforthianum	Climbing Nightshade

Herbs & Groundcovers

Ageratina adenophora	Crofton Weed
A. riparia	Mist Weed
Ambrosia artemisiifolia	Ragweed
Bryophyllum delagoense	Mother-of-millions
Bryophyllum pinnatum	Resurrection Plant
Callisia fragrans	Callisia
Canna indica	Canna lily
Chlorophytum comosum	Ribbon Grass
Commelina benghalensis	Hairy Wandering Jew
Crocosmia x *crocosmiiflora*	Montbretia
Euphorbia cyathophora	Painted Spurge
Impatiens walleriana	Busy Lizzie
Protasparagus aethiopicus	Ground Asparagus
Rivina humilis	Coral Berry
Salvia coccinea	Red Salvia
Sansevieria trifasciata	Mother-in-law's Tongue
Tradescantia fluminensis	Wandering Jew
Tradescantia zebrina	Striped Wandering Jew

Ferns

Nephrolepis cordifolia	Fishbone Fern

Epiphytes

Tillandsia usneoides	Old Man's Beard

Hemi-epiphytes

Hylocereus undatus	Night-blooming Cactus

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SOME NEW WEED CONTROL OPTIONS FOR LOCAL GOVERNMENT AND OTHER PUBLIC AUTHORITIES.

Solving Problems And Managing Resources.

Geoff Keech
Sales Supervisor
Macspred Pty. Ltd.

THE PROBLEM

"Weedologists" throughout NSW, and indeed Australia, are faced with ever increasing pressures to control weeds more economically, more efficiently and within given time frames, with fewer chemicals, less labour and without causing damage to the environment. Many outside influences and obstacles are placed in the path of these intrepid weeders, causing them to run behind schedule, have blow-outs in their budgets and face problems with some community attitudes.

The weather, to mention one, is always trying to find an excuse to disrupt the best laid plans of the most conscientious manager. If not too dry then its too wet or too windy or too hot or a frost has caused a dormancy, rendering the use of a herbicide ineffective. This problem we can only do so much about. However, there are still outside jobs which may be done under some of these unpredictable patterns in the weather.

THE SOLUTIONS

Beating The Weather And Saving Time

While I don't expect anyone to work outside in a force 10 gale or during a monsoonal downpour, there is work that may be done during periods of inclement weather. Guard rails, guide posts and other roadside furniture can be treated for weed control in many different conditions by using either Oust®, Enviromac G® or Visor®. Visor is a new chemistry herbicide containing 240g/L THIAZOPYR, with activity against grasses and some broadleaved weeds.

Oust® does not have to be absorbed by actively growing leaves. Whilst there is some leaf uptake, the main route of control is by root uptake, negating the need to observe rainfast periods. So, Oust® may be applied during showery weather as long as Roundup® is not being used as a tank mix. Oust® is also UV stable, so it can remain on the surface of the soil until sufficient rain falls to take it into the soil profile (Du Pont, undated). The same can be said for Enviromac G® a granuar product. These two products can be used when it is too hot, cold, showery or dry to use other products (Oust® should not be applied to waterlogged soils). In fact they make better use of time available.

If the choice is Enviromac G® applied through a Weed-a-metre, any of the outdoors staff can be utilised to treat guide posts and signs when they cannot undertake their normal work tasks. Granular herbicides are not effected by wind to the same extent as liquids, don't require messy washdown of equipment or have the need to constantly refill spray tanks with water.

Environmental Safety

Generally speaking, herbicides with long lasting residual activity tend to leach down to tree roots - or worse into the groundwater. On the other hand the 'safe' herbicides don't offer much residual

activity. Visor offers both residual control and environmental safety. It lays down a residual barrier that will block out annual grasses and some broadleaf weeds for months. Yet it is so safe and consistent that it can be applied around most trees even when they are small. Visor does not build up in the soil even after several seasons of application. It is degraded by both soil micro-organisms and aqueous photolysis, herbicidal activity ending when the season does.

Visor® is also UV stable and may be applied to bare soil under any conditions, however the normal rainfast periods need to be observed when tank mixing with Roundup®. Visor® may also be the choice if heavy rain is expected soon after application as once the product has entered the soil, it does not move (Rohm and Haas, undated). Long term weed control around roadside furniture may also be obtained using Visor®. This product is stable in the soil profile and will not leach into sensitive areas, making it ideal for areas previously not suited to the application of Oust®, such as sensitive areas near neighbours, susceptible trees and other desirable vegetation, and near aquatic situations.

Replacing Lost Products

With The demise of Frenock®and the removal of industrial uses from atrazine labels, many local government areas are looking for an effective method of controlling giant Parramatta grass (GPG), along roadsides and in industrial and non grazing areas.

There is an answer. Oust® has been used suceessfully at low rates to manipulate the species content of roadside vegetation. The experience of Paul Leddy at Kempsey, where he has used Oust® (Sulfometuron Methyl) at 300 grams per hectare plus Roundup® (360 grams / Litre Glyphosate) at 3 litres per hectare on roadsides, has shown good control of annual species and GPG while maintaining a cover of couch and Rhodes grass. Similar experiences at Narrabri indicate that Johnson grass control can also be achieved with low rates (anecdotal evidence, Ron Baker, Narrabri Shire Council Chief Weeds Officer, retired).

Refining The Techniques

To further build on the information available on the susceptibility of GPG to Oust®, Paul Leddy has planned to lay down some small plot trials this year at Kempsey, using 2 litres of per Ha. Roundup® and 100, 150, 200 and 250 grams per Ha. of Oust®. This small area will give an indication on the optimum rate of chemical an allow an assessment on the most economical rates to be used.

Cost Efficiency

As with all herbicides, the choice comes down to dollars and cents, and the weed manager should look carefully at all aspects of alternate methods before choosing an option. Manipulating roadside vegetation by slashing or with Roundup® by chemical mowing (Monsanto, 1994) is an operation needing repeated applications, especially during warm moist weather. The total cost of these operations for the season needs to be looked at ie., labour, plant and chemical for several applications vs a single pass utilising a soil active herbicide (Roundup® may or may not be needed).

An example of cost comparisons is shown in Table 1.

Slashing alone will not control GPG, in fact it will help to spread it. Any management plan based on slashing would have to include the cost of spot spraying as an extra. Chemical mowing also will not

control mature GPG, even though strategic spraying may sterilise some seed set. Because of the extended flowering period of GPG, as noted in Parsons and Cuthbertson 1992, the repeated herbicide applications necessary to achieve total seed sterilisation would become prohibitive and, the vagaries of the weather preventing strategic spraying, render the system non practical.

Table 1.

Cost Comparisons Between Slashing and Residual Herbicides.

Slashing Costs		Spraying Costs	
Slasher / hr	$22.00	Spray Contractor	$7.00 / km
Operator / hr	$24.00	Roundup cost	$7.50 / L X 30L / 50 km (approx. 3 L / Ha) =$4.50 / km
Contract Slashing / hr (*alternative to Council)	$59.00	Oust cost	$440.00 / kg X 3 kg/ 50 km (approx. 300 gm / Ha.) = $26.40 / km
Km treated / 8 hr day	6 average	Km treated / 8 hr day	80
Number of treatments	3	Number of treatments	1
Cost to treat 80 km (one treatment)	$4906.50 to $62800.00	Cost to treat 80 km	$3032.00
Cost per kilometre per year (3 treatments)	$184.00 to $235.50	Cost per kilometre per year (1 treatment)	$37.90

Based on average cost for Kempsey Shire Council, 1998.

NEW USES

Weed Control in new plantings of Eucalypts and Pine trees is now possible with Visor®.

Trials and practical use has shown control for between six and nine months on a variety of emerging grass and broadleaved weeds in eucalypt plantations in north eastern NSW (as observed in a Macspred herbicide screening trial, 1998). The trees in this trial responded to the weed free conditions afforded by Visor® in overall growth, showing increases in height and diameter over the nil treatment. A summary of results is shown in table 2. Visor can be used both pre and post planting when applied to bare earth, or may be tank mixed with Roundup® in a pre planting situation where small weeds are present.

Table 2.

Growth Response Of Five Eucalypt Species To Visor Applied Pre Plant, Compared To Untreated.

	Treatment								
Species	Visor @ 2 lit/Ha			Visor @ 4 lit/Ha			Nil Treatment		
Measurement	Height in mm	Diameter in mm	Volume Index	Height in mm	Diameter in mm	Volume Index	Height in mm	Diameter in mm	Volume Index
E. dunnii	1606	18.5	54965	1967	23.8	111418	853	5	21325

			3			7			
E. grandis	1863	21.1	829426	1960	21.4	897602	996	7	44804
E. pilularis	1237	13.2	215535	1228	13.2	213967	635	2	2540
E. maculata	1216	12.1	178035	1281	13.5	221981	792	3	7128
E. cloeziana	1133	9.9	111045	1280	12.4	196813	664	2	2656

Volume Index = Diameter ^{2} X Height. Height and diameter measurements are the means from each plot. All treatments were tank mixed with 6 litres per Ha. Roundup® with the exception of the nil treatment.
Source: Maespred Pty. Ltd. Herbicide Screening Trial, "Inglebar", Jackadgery, Established 8/12/97, Planted 23/12/97, Measured 3/12/98.

Because Visor® has no effect on established plants or tube stock which has been transplanted, "over the top" applications are possible. This allows the maintenance of weed free situations where previously, repeated applications of a knockdown herbicide or whipper snippers had to be used. It would be important to apply Visor®, in this situation, as a programmed treatment before the anticipated germination of weeds, to achieve good weed control and tree growth. A more expensive option would be to add a suitable selective herbicide.

For long term control of certain broadleaf weeds known to be tolerant to Visor®, tank mixing with a compatible pre emergent herbicide is possible. In a Macspred demonstration along a cycle way in Ballarat, Visor® was used at a rate of 200 mls per 100 litres of water with a tank mix of 5 grams of Oust® and 1 litre of Roundup® per 100 litres. This mix gave excellent long term weed control with a defined edge in the turfed area.

Further applications for Visor® under a pesticide permit may become available after trials are conducted. These may include seasonal grass weed control in regenerating native areas or weed control in a variety of non eucalypt tree crops. There is great potential for this product in most amenity horticulture situations.

TAKE HOME MESSAGES

The clear message is, that by careful planning and research, we can make better use of available herbicides which are safe to the environment. Be prepared to ask questions - of Macspred, your neighbouring weeders, commercial representatives, relevant Government Departments and any other person involved in land management. Collect the information, weigh it up as it applies to your problem area, and don't be afraid to carry out small trials. Be aware of environmental constraints and select the most appropriate herbicide or control method for the site. Always consider your options, do your costings, read the label and KEEP IT LEGAL.

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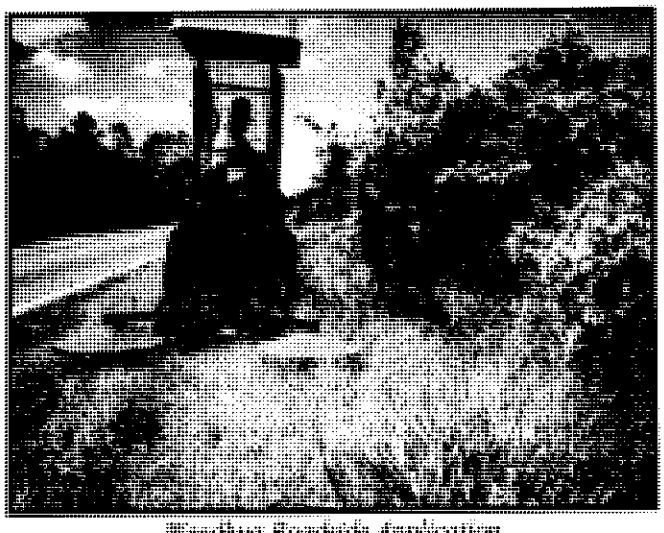
Benefits of Weedbug Technology on Roadsides



Weedbug Roadside Application

Cost Benefit

- Reduction in total overall roadside vegetation control costs achieved by reduced need for mowing.
- Less road closure and traffic control costs, this also reduces the inconvenience to motorists.

Aesthetic Improvement

- Changes plant community, leading to a more aesthetically appealing low growing grass.
- Reduction in spread of noxious weeds by slasher.
- Weedbug equipment manages weed control so that only the tall weed species are eradicated. This allows the shorter species of vegetation to completely colonise an area and prevent erosion.
- Weedbug Technology is low costing erosion control in areas which are currently difficult or unable to be maintained adequately due to prohibitive cost or terrain. Eliminates the need for "Scorched Earth" results achieved by conventional spraying.

Reduction in regrowth of feral pine trees on the sides of roads, leading to better aesthetics and reduced costs from separate contracts.

Safety Improvement

- Safer roads as a result of providing a continuous compliance of current intervention levels.
- Reduced claims from motorists for damage to vehicles by objects thrown from blades of slasher, due to reduction in number of mows.
- Due to the reduced number of mowing passes required there is a reduction in the risk to employees/contractors inherent in roadside work.
- The low growing grass together with the road creates a fire break.

Before Weedbug Involvement

First session after commencement of Weedbug Program.

Weedbug Services Pty Ltd
76 Northlink Place, Virginia, Q 4014
Ph: 07-3260 8900 Fax: 07-3260 8999

REVIEWS OF ENVIRONMENTAL FACTORS FOR WEED CONTROL

The rich and varied rewards of undertaking Environmental Impact Assessment for weed control activities

Sonia Mellor & Joanna Muldoou
Environmental Planning Officers
NSW National Parks & Wildlife Service

INTRODUCTION

The National Parks and Wildlife Service (NPWS) recognises that the presence and invasion of exotic plants may constitute a serious threat to the integrity of the natural resources of lands managed by the NPWS. The NPWS controls exotic plants on NPWS managed lands in order to meet our conservation objectives for these lands.

This paper briefly outlines the statutory framework that determines the priorities for weed management on NPWS estate and that assists in planning and implementing weed control. We contend that Environmental Impact Assessment (EIA) can be used as a planning tool to assess the likely impact of an activity before it is carried out and the results of this process can then provide feed back into future weed management decisions.

LEGISLATIVE REQUIREMENTS

There are a number of statutory requirements which necessitate the control of environmental weeds on NPWS estate.

Under the *National Parks and Wildlife Act 1974* (NPW Act), NPWS is responsible for the protection and care of protected flora, fauna and to care, control and manage parks and historic sites.

The *Threatened Species Conservation Act 1995* (TSC Act) requires NPWS to:

- eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities; and
- to prevent the extinction and promote the recovery of threatened species, populations and ecological communities.

Under the *Wilderness Act 1987*, NPWS is responsible for the carrying out of works necessary in connection with the protection, management and maintenance of the area. A wilderness area shall be managed so as to restore and to protect the unmodified state of the area and its plant and animal communities.

Under the *Noxious Weeds Act 1993* public authorities like NPWS have a responsibility to control the noxious weeds on the land they occupy to prevent their spreading onto neighbouring lands.

While these legislative provisions require NPWS to control weeds for environmental and agricultural protection reasons, other provisions apply to the potential impact of weed control works.

The NPWS, as the Government's principal authority responsible for biodiversity and cultural heritage conservation throughout the State, has a duty to ensure its own activities are environmentally sound and comply with the law. Efforts to control environmental weeds, if not properly planned and conducted, have the potential to be as damaging as the weeds themselves. NPWS considers that environmental impact assessment is required for many works on NPWS estate in order to comply with NSW planning legislation.

When does the EP&A Act apply to weed control?

NPWS consider many weed control programs on lands managed by NPWS require approval under Part 5 of the EP&A Act. Part 5 of the EP&A Act deals with *activities* for which development consent under an environmental planning instrument and Part 4 of the Act are not required, for example for actions which do not require consent from a Local Council.

"Activity" is defined in s.110 of the EP&A Act as -
* the use of land;
* the carrying out of a work;
* the use of land or of a building or work; and,
* the subdivision of land.

Whether or not a particular action is an activity under the EP&A Act is not always simple to determine, for example, the spraying of herbicide has been determined by the Land and Environment Court as not being an activity under the EP&A Act (see Rundle-v-Tweed Shire Council). NPWS applies its own judgement in determining whether a proposed weed control program is an activity.

NPWS undertakes a Part 5 assessment in the form of a Review of Environmental Factors (REF) to determine whether adverse environmental impacts are likely. If the impacts are considered to be significant the preparation of a more extensive assessment report, an Environmental Impact Statement (EIS) is prepared. In reality, if the REF determined that a significant effect was likely (and therefore an EIS required), the proposed activity would be modified to reduce the impact before being carried out.

Does the *Threatened Species Conservation Act 1995* apply to weed control?

Under the TSC Act, approval is required for any action that may harm, pick or damage threatened species, populations or ecological communities or their habitat but only where this action does not have approval under any other environmental planning instrument and where the action is not a routine agricultural activity. If proposed weed control works have approval under the EP&A Act or are a routine agricultural activity the TSC Act would not apply. The NPWS environmental assessment system ensures NPWS complies with the EPA Act and avoids the need for any additional approval under the TSC Act.

THE NPWS ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

Why bother with environmental assessment of weed control?

NPWS policy states that weed control measures will be assessed and periodically reviewed to determine their effectiveness in achieving control over target species and any residual or continuing environmental impacts. This makes sense for any practitioners of weed control programs. We believe that the best way to address the need for review and environmental monitoring is by producing an REF.

There are a range of environmental impacts that may result from weed control. These include:

- siltation of waterways due to removal of weeds within riparian areas, particularly where the weeds form a monoculture over extensive areas;
- soil erosion;
- contamination of waterways from herbicides;
- incidental destruction of native flora including threatened flora;
- destruction of habitat of fauna including threatened fauna; and incidental damage to vegetation communities with high conservation significance.
- Adequate consideration of environmental factors prior to undertaking weed control can: ensure all available options for weed control are properly assessed and their advantages and disadvantages weighed;
- assist in identifying whether mitigation measures are required; and
- assist in identifying when and where monitoring can be used to determine the impact of the action or the effectiveness of the control technique.

Other benefits of environmental assessment

When NPWS conducts an REF for weed control work, this results in a documented and transparent account of the environmental, social and economic factors taken into account before the activity was carried out. The decision to proceed or not to proceed, or to modify the activity can then be justified to external parties.

The assessment process can also provide an opportunity to invite comment from the public or selected interest groups. NPWS might seek external comment on weed control works where:

- the proposal will affect a large area, especially areas with public interface;
- there is likely to be a high public interest in the activity; or
- the action may be controversial.

Aerial bitou bush spraying of large coastal areas close to residential areas would be an example where NPWS may seek public input. Public participation assists NPWS in balancing environmental considerations with social and economic factors.

Factors to consider when assessing environmental impact

The factors considered by NPWS when undertaking a Review of Environmental Factors with particular relevance to weed control are listed in Appendix 1. This has been amended to emphasise the issues relevant to weed control while still meeting the statutory requirements of the EP&A Act (and Regulations) and other legislative and policy requirements.

The environmental issues specific to weed control that require special attention in an REF include potential impact on:

- Threatened fauna/flora
- Non-target species (both flora and fauna)
- Health and safety for employees and the general public
- Impact on sensitive area such as waterways
- Cumulative impact
- Monitoring
- Aboriginal food sources.

NPWS acknowledges that our current information on these issues is far from complete. With improvements in our EIA process helping to direct further research and monitoring we hope to improve our performance in weed control and effectively manage the surrounding environment.

If a REF is to be conducted for weed control activities, it makes sense to consider assessment of a weed strategy as a whole. In NPWS, REFs have been carried out for weed control programs of 3 to 5 years covering a number of National Parks and a number of techniques. REFs have been produced in NPWS for:

- a 5 year program of annual aerial spraying of bitou bush over several large coastal reserves;
- an annual program of blackberry control over several reserves in a region using a variety of techniques;
- an ongoing program of weed control for several species, using a variety of techniques, in a single reserve.

There is a number of NPWS policies which assist in planning weed control works. These include Plans of Management for each Park or Nature Reserve, a Pest and Weed Control Strategy which has been developed for most NPWS Districts, Recovery Plans for threatened species and Threat Abatement Plans that have been prepared under the TSC Act. These policies ensure that those resources available for weed control are directed in the most efficient and effective manner on a State, regional and local scale.

Balancing Conflicting Management Aims

This requirement of the EP&A Act to consider social and economic impacts, with the added responsibilities of NPWS to protect natural, cultural and historic heritage can present some interesting management dilemmas. The conflicting issues, likely impact and level of public interest of all these examples can be explored and resolved through the environmental planning process. In many of these cases, eliminating weeds is not a viable option and management must focus on containment and prevention of spread from existing weed populations.

- Dense stands of weeds have in some cases been found to protect the remains of historic buildings from erosion from wind and rain. For example, the removal of a dense thicket of

- blackberry over the compacted mud walls of a historic building in Barren Grounds, Kosciusko National Park, resulted in the rapid erosion of these walls. After considering other options allowing the weeds to return was found to be the most effective and least obtrusive means of protecting this building.
- Exotic species can have a cultural importance to some park users. For example, NPWS efforts to control fruit trees and conifers in popular picnic sites have been met with some protest from regular visitors who see these exotics as an important part of the landscape and add to their enjoyment of the park.
- Some threatened fauna have adapted to weed dominated environments, particularly where their natural environments have been reduces. For example, the Black-breasted Button Quail (*Turnix melanogaster*) is known to inhabit lantana thickets.
- Mechanical means of weed control are often more cost effective for larger infestations but the consequent disturbance to natural and cultural features in the vicinity of the infestation or along access routes can make certain techniques enviable.
- Exotic gardens can in themselves be considered historic sites of significance, for example where they were once a part of an extensive homestead.

As land managers, NPWS has a responsibility for the protection and conservation of environmental values within a national park. Although EIA for some methods of control is not required under the EP&A Act, preparing a REF provides a transparent assessment and decision making process which may help to reduce impact on environmental values, reduce conflict in the community and provide a level of accountability to management actions.

TAKE HOME MESSAGES

* The control of environmental weeds if not properly planned and conducted, can be as damaging as the weeds themselves. Assessing the environmental impact of weed control enables proponents to determine whether a given project should proceed, what alternative control strategies might be available and what mitigation measures can be applied.

* A legislative framework applies to guide the assessment of impacts. The relevance of the EP&A Act, other environmental planning instruments and agreements should be considered prior to conducting weed control works.

* An environmental assessment process ensures the manner in which weed control works are undertaken can be justified to concerned parties and is a mechanism to encourage informed public comment and participation.

* An environmental assessment process enables areas of uncertainty to be identified. Monitoring or auditing the impact of the works and/or the effectiveness of the works on weed control can then be identified.

APPENDIX 1: NPWS REVIEW OF ENVIRONMENTAL FACTORS

The NPWS REF format is outlined below with amendments to reflect the environmental issues specific to weed control activities.

CONTENTS CHECKLIST

1. PLANNING

- Local, regional and state wide planning and policy frameworks may be applicable. Is the proposal consistent with the existing zoning of the area on a local, regional and state wide planning framework?

I. Is the activity permissible under relevant acts such as:
   A. the Noxious Weeds Act
   B. the EP&A Act
   C. the Rural Fires Act

II. Does the proposal affect lands protected under State Environmental Planning Policies including;
   A. SEPP 14 - Coastal Wetlands
   B. SEPP 26 - Littoral Rainforests

III. Does the proposal affect lands or species protected by International Agreement or Treaty e.g. Wetlands areas dedicated under the Ramsar Wetlands Convention

IV. What legislation, standard codes or guidelines are available to properly monitor and control operations on site? [eg. Best Practice Management Guidelines]

2. THE ACTIVITY

- Describe the activity (eg. what techniques will be used, where, for how long)
- Objectives/ Justification for the activity
- Future Implications

3. ALTERNATIVE PROPOSALS

Assessment of alternative proposals including alternative techniques for weed control.

4. EXISTING ENVIRONMENT AND LANDUSE

- Describe the existing environment where the work is proposed including the present landuse. The natural, cultural and social environment should be described including an assessment of the significance of the existing environment.
- Is it an existing or potentially environmentally significant area? [examples include: riparian zones, littoral rainforests, old growth native vegetation, wetlands, wilderness areas, remnant vegetation, threatened species habitat]
- Erosion prone areas, areas with slopes of greater than 18 degrees.

5. ENVIRONMENTAL IMPACTS

What are the likely environmental impacts of the proposed activity. This should include consideration of the magnitude of the impacts, their spatial extent, the duration and intensity of change, whether and how the impacts are manageable.

Impacts on the natural environment

I. Soils (nutrients/ erosion/ disturbance)
   A. degradation of soil quality including contamination, loss of soil from wind or water erosion, loss of structural integrity of the soil.

II. Flora (including trees, shrubs, grasses, herbs or aquatic plants).
   A. General impact on native vegetation
   B. 8 point test for TSC Act species/populations and their habitat

C. Other Rare or Threatened Australian Plants (ROTAP) species and species/communities of significance

III. Fauna (including mammals, birds, frogs, reptiles, insects, fish or crustaceans).
A. General impact on protected fauna
B. 8 point test for TSC Act species/populations and their habitat
C. Other species of significance

IV. Ecological Communities
A. 8 point test for TSC Act ecological communities

V. Water Catchment (quality/ quantity/ drainage)
A. Will there be any contamination of waterways from chemicals or siltation as a consequence of weed removal.

VI. Exotic Species (clearly outline the predicted impact on the target species and any other exotic species as a result of the proposed works)

VII. Fire

Impact on cultural environment

Outline any impacts on:

- Known Aboriginal sites
- Known historic sites
- Cultural landscapes (including historic plantings of introduced species)

Impact on social environment

Outline any impacts on the health, safety, security, privacy or welfare of individuals or communities because of factors such as air pollution or noise. Consider the issues below:

I. Contact with Aboriginal Land Council (especially relevant on areas subject to land rights claims or when known bush food resources will be impacted)

II. Traffic/ Roads

III. Noise

IV. Neighbours/ Local Residents
A. What is the level of public concern?
B. Is the proposal controversial or could it lead to controversy or concern in the community?
C. Will the amenity, values or lifestyle of the community be adversely affected?

V. Safety for employees/ visitors
A. Could carrying out the activity give rise to health impacts or unsafe conditions

VI. Energy Use

VII. Education

VIII. Scientific

IX. Recreation

X. Wilderness/ wild and scenic rivers

XI. Scenic and visual

XII. Waste disposal (especially of chemical refuse)

XIII. Other

Financial Impact Assessment

Include any impacts that result in a direct cost to the community or individuals.

6. CUMULATIVE IMPACTS

Any barrier to the normal replenishment or revegetation of existing species following disturbance. This is especially relevant to potential impacts from the use of pesticides, herbicides, fertilisers or other chemicals which may build up residues in the environment

7. PROPOSED ENVIRONMENTAL SAFEGUARDS

How well can the impacts be mitigated? Outline how the work will be undertaken to minimise impact on the environment. Address the following criteria where relevant:

- Protection of significance (including threatened species, waterways, native vegetation)
- Erosion control/ sediment (relevant to broad scale applications and erodible soils)
- Pollution control [air, water, ground] (emergency procedures for spillage etc.)
- Plant rehabilitation
- Safety/ maintenance (safety of staff and the general public and any follow up work required. Are contingency or emergency plans proposed or in place to deal with accidental events

8. REVERSIBILITY

- Can the impacts be reversed?
- Can the surrounding environment absorb the level of impact predicted without suffering irreversible change?

9. MONITORING

- How well can the impacts be predicted?
- Is it practicable to monitor predicted effects?

10. CONSEQUENCE OF NOT CARRYING OUT THE ACTIVITY

To both outside stakeholders and to yourself and your organisation.

11. SUMMARY OF PUBLIC SUBMISSIONS

If the REF has been placed on public exhibition then provide a summary of the public submissions received.

12. CONCLUSIONS AND RECOMMENDATIONS

One of the following conclusions or recommendations should be arrived at:

- The proposal will not have a significant impact on the environment and is therefore approved; or
- the proposal will be modified to avoid a significant impact on the environment and is therefore approved subject to conditions; or
- the proposal will have a significant impact on the environment and an environmental impact statement (EIS) is required; or
- the proposal is on land that is or is part of critical habitat or is likely to have a significant effect on threatened species, populations or ecological communities, or their habitats and a species impact statement and an EIS is required; or
- the proposal will have a significant impact on the environment and should not proceed.

MANAGEMENT OF GIANT PARRAMATTA GRASS (*SPOROBOLUS INDICUS* VAR. MAJOR) ALONG ROADSIDES - AN INTEGRATED PEST MANAGEMENT APPROACH

Andrew Storrie and Tony Cook
Tamworth Centre for Crop improvement,
NSW Agriculture, RMB 944, Tamworth, 2340

INTRODUCTION

Giant Parramatta grass (*Sporobolus indicus* var. major) (GPG) is a major pasture weed of the NSW north coast and is found from Nowra to Cooktown. GPG's weediness can be attributed to the low palatability of tussocks, prolific seed production (Andrews, 1995) and the stickiness of the loosely held seeds when wet.

This stickiness of the wet seeds is a highly effective means of dispersal by stock, native animals, machinery and vehicles.

Despite the presence of GPG in NSW since the 1880's, rapid spread only really started in the mid to late 1960's, which coincided with the development of large scale road transport of stock, the decline in the dairy industry (Laffan, 1985) and the increased mobility of people with the introduction of affordable cars such as the Austin A40 and the Morris Minor.

Despite being declared a noxious weed in 1981 and local government expending nearly $2 million of public money over the last 8 years spraying this species, GPG has continued to extend its range as well as increase in density on the north coast of NSW.

Dramatic changes in demographics of the north coast have also led to changing attitudes to herbicide spraying (Storrie & Ensbey, 1997). In a number of areas populations have increased by nearly 90% with total area to agricultural production dropping by over 40%. People are more wary of the use of pesticides and this precipitated community conflict within the shire of Bellingen over the control of GPG along the roadsides.

Roadsides were the focus because the sticky seeds of GPG were seen as a threat to non-infested areas. Vehicles could pick up seeds by driving through some GPG on the roadside and then travel up to 1000 kilometres in a day, carrying the seed with them.

On the other hand the roadside management objectives of aesthetics, functionality and safety were not considered.

This led to the involvement of NSW Agriculture, the formation of the Bellingen Roadside Management steering committee and ultimately to the development of the Bellingen Roadside Management Plan (Storrie & Ensbey, 1997).

An important part of this process was the implementation of a trial to compare a range of techniques for the management of GPG on roadsides which was first described by Ensbey & Storrie (1997). The trial is looking at both chemical and non-chemical techniques and focussing on changing botanical composition of the sward for a wide range of objectives, including safety, cost, erosion prevention and sustainability, not just the control of GPG.

The Trial

The trial is located on a podsolic soil 10 km west of Bellingen. The trial is in a grazing paddock to overcome effects of roadside variability and improve operational safety. Cattle were excluded with electric fencing.

Soil pH($CaCl_2$) is 4.5 and initial soil phosphorus level of 4 ppm (Bray).

No new species were introduced to the trial, with the aim to manipulate the species already present.

There are 13 treatments replicated three times with plots 20 m by 3 m. Five treatments have received annual applications of phosphorus and sulfur as single superphosphate.

The trial was commenced in the winter of 1996. Several of the treatments have evolved as the trial progressed as it became clear they were not meeting roadside management objectives.
Treatments are as follows:-

1. Slashing - as required
2. Rotary-hoeing + mulching (to simulate road works)
3. Flame cultivation (winter) + Slashing + Weedbug™ (summer)
4. Slashing (spring) + Weedbug™ (summer)
5. Frenock® 1.5 L/ha - Rae™ wiper (August, 1996)
6. Frenock® 1.5 L/ha - boom spray (July, 1996)
7. Flame cultivation (spring) + Slashing + Weedbug™ in summer
8. "Non-tox"® herbicide /// now Swazi grass + Weedbug™ (since September, 1998)
9. Slashing + superphosphate
10. Slashing (spring) + Weedbug™ (summer) + superphosphate
11. Frenock® 1.5 L/ha - Rae™ wiper (August, 1996) + superphosphate
12. Frenock® 1.5 L/ha - boom spray (July, 1996) + superphosphate
13. Flame cultivation (winter) + slashing + Weedbug™ (summer) + superphosphate

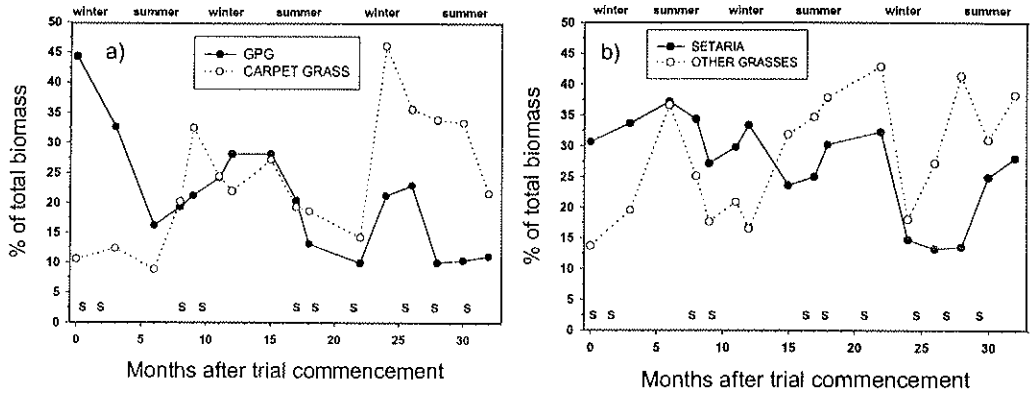
Assessments were every 6 weeks (approx.) where changes in botanical composition were estimated using the "botanal" technique (Tothill *et al.*, 1978). Categories assessed were GPG, setaria (*Setaria sphacelata*), Carpet grass (*Axonopus affinus*), "Other" grasses which included; bahia grass (*Paspalum notatum* cv. Pensicola), kangaroo grass (*Themeda australis*), whisky grass (*Andropogon virginicus*), blady grass (*Imperata cylindrica* var. major), broad leaf paspalum (*Paspalum weylandii*) and lastly a category of broad-leafed species, mainly consisting of clovers (*Trifolium* spp.) and broad-leaf weeds.
Slashing was done with a 10 hp Deutscher walk-behind mower at a height of 7 cm (maximum setting).
Flaming was initially done with a 3-point linkage liquid propane prototype tunnel developed by Elgas. Subsequent flaming used a hand held liquid propane Weed Dragon™.
Rope wicking treatments utilised the Weedbug™ rotary wiper for glyphosate and the Rae™ wiper to apply Frenock® in treatments 5 &11.
Frenock® was also applied at 1.5 L/ha (T6 & T12) using a CO_2 powered hand held boom in 110 L water per hectare.
Mulched plots were rotary hoed twice to kill any vegetation, prior to mulching, to simulate roadworks.

RESULTS AND DISCUSSION

Slashing

Slashing is the most widely used technique for roadside vegetation control in Australia.

Figure 1: Effect of slashing only on botanical composition



S = slashing

Figures 1a and 1b show the effects of slashing on botanical composition to date. There is a general downward trend in the level of GPG with an opposite upward trend in carpet grass. Setaria fluctuates widely, however shows a general decline, particularly as slashing frequency increases. Other grasses show a general increase due to an increase in the frequency of bahia grass (*Paspalum notatum* cv. Pensicola), kangaroo grass (*Themeda australis*) and whisky grass (*Andropogon virginicus*).

There are three factors influencing the trends in this treatment.

The frequency of slashing was increased from January, 1998, because tussock grasses were becoming too tall for roadside safety.

Firstly an overall trial effect of the exclusion of cattle and therefore removing selective grazing. It is well known that continuous grazing (set stocking) increases the level of GPG in pastures (Hildago & Cauhepe, 1991; Mears *et al.*, 1996). Removal of stock has seen an increase in more palatable grasses which effectively compete with GPG.

Mowing height and frequency is also known to strongly influence botanical composition of swards. Mowing height has remained a constant 7 cm for the period of the trial.

Tinklin (1988) surveyed 50 roadside verges in England and found that high intensity mowing led to a reduction in the total number of species present, with a shift towards low growing species such as flat weeds.

A reduction in mowing frequency of parks by the Brisbane City Council since 1998 has led to a shift from green and blue couch (*Cynodon dactylon*) to bahia grass, which grows up to 250 mm high, and is a less favoured recreational turf (E. Stevens, pers. com. 1999).

A number of studies in the turf industry have shown that mowing heights of over 7 cm improve turf competition with weeds and reduces weed invasion (Black & Turgeon, 1974; Dernoeden *et al.*, 1993; Powell & Mortimer, 1972).

Low slashing heights can also lead to increased frost damage to desirable species, (Davies & Hunt, 1989), which is particularly important in colder areas.

Despite being popular with road managers, slashing has some severe deficiencies when viewed from a broader perspective. In high rainfall environments it is physically impossible to slash all roadsides as often as required from October to March. The slashing frequency required to produce desirable shifts in botanical composition which makes slashing a poor option on all but small stretches of road close to town.

The cost is also relatively high due to the high labour requirement of moving safety signs and the low number of kilometres treated per day. Slashing has also been strongly implicated in the spread of a range of weeds including GPG.

Cultivation and mulching
This treatment was included to simulate an option following engineering works.

Plots were rotary hoed twice to kill existing vegetation, then recycled garden waste was applied to a depth of 100 mm.

This mulch lasted around 18 months before being totally decayed and requiring replacement under the high rainfall, warm conditions of the mid north coast.
Setaria established as the mulch began to decay, mainly through culms which had survived the cultivation. *Kennedia rubicunda*, white cedar and introduced *Cassia* spp. established in some plots, most likely as a result of seed being present in the mulch.

The aim of mulch is to prevent establishment of weeds, yet allow re-establishment of suitable vegetation such as trees, shrubs and ground covers.

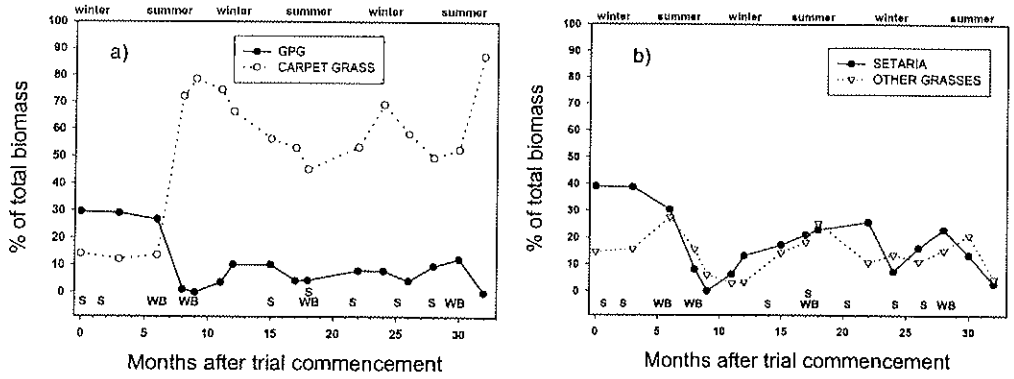
Factors to consider when using mulch are:-
- source - are there likely to be contaminants?
- preparation - must have all unwanted vegetation removed or killed, otherwise it will emerge through all but the deepest mulch
- type - how long will it last under the prevailing conditions?
- safety - must only be used where it will not be blown or washed onto roads

Application of glyphosate with Weedbug™ rope wick
Weedbug™ was used to selectively apply glyphosate to taller species and thereby push botanical composition towards lower growing species such as carpet grass and bahia grass.
Weedbug™ is a system of hydraulically driven, spinning discs, with wicks radiating out from a central reservoir. Centrifugal force keeps the ropes wet, and rotational speed can be adjusted "on-the-go" depending on density of the target. The spinning action gives good one-pass coverage of the target, and may abrade the plant cuticle facilitating greater absorption of herbicide.

Seven treatments include the Weedbug™ at some point, usually in combination with slashing pre-treatments.

Flaming is also included in treatments 3, 7 and 13. Flaming is the rupturing of plant cells with short duration exposure to high temperatures, as opposed to burning vegetation.
There are no significant differences between any of the Weedbug™ treatments.
Figure 2a shows that GPG is quickly reduced to less than 10% of the total biomass, while carpet grass fluctuates from 50 to 80%. The decline in setaria is evident in figure 2b. Other grasses fluctuates because it includes some tussock grasses such as whisky grass as well as the more prostrate bahia grass, which is increasing in the Weedbug™ plots.

Figure 2: Effect of slashing and Weedbug™ glyphosate applications on botanical composition



S = slashing WB = Weedbug™

Pre-management of the sward is critical for effective rope wick operation. Slashing must take place prior to the major growth period of the target species to lower desirable species, and remove excessive biomass of tall species. This management will enable glyphosate to be applied to fresh regrowth of the taller target species without contacting the desirable species.

In the case of GPG control at Bellingen, the optimum time for slashing in 1997 was mid November with the first rope wicking in early January, and the follow-up application in March. However in 1998, a wet and warm spring-summer meant that a growth rates of most species was greater and a 4 week interval between slashing and the first rope wicking was optimal. Waiting till January led to more damage to carpet and bahia grass due to their greater height.

Therefore timing of rope wicking will vary from year to year.
Flame cultivation had no effect on established perennials, but did control seedling annual broad - leafed plants. Flaming is likely to control small seedlings of perennial grasses such as GPG, however no seedling recruitment has occurred in any treatment. Ascard (1995) showed that flaming was best suited to the control of seedling broad-leafed weeds and the larger the seedlings the more energy (gas) was needed.

Flaming might be useful in reducing surface seed banks of species such as GPG, which is a surface seeder and the shape of the seed means that it will remain near the surface due to their ovoid shape and most soils where it occurs are non-cracking. Further work will be conducted to test this theory in 2000.

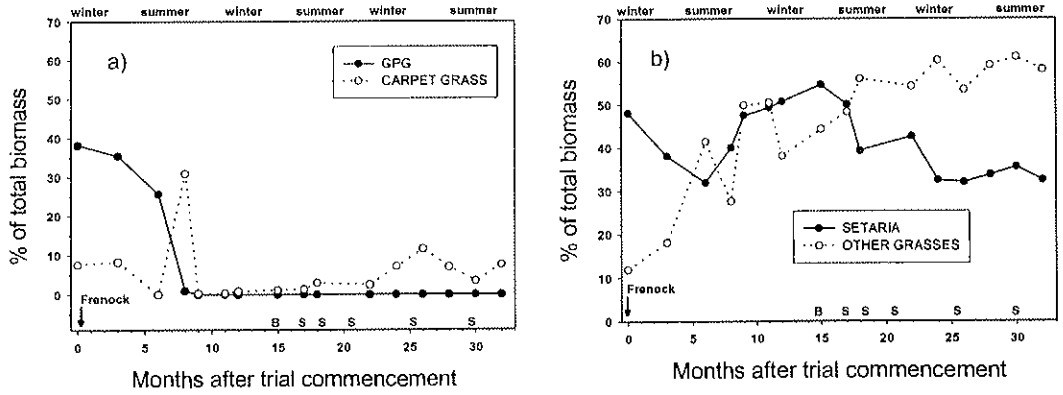
Frenock® treatments
There were no significant differences between the application methods in the control of GPG. Both were highly effective, although boom spraying gave slightly better control.

Rope wicking was done with 2 opposite passes of the Rae™ machine, to apply 1.5 L/ha of Frenock®.

Figure 3a shows excellent control of GPG, with a severe retardation of carpet grass which only begins to recover 18 months after application. Rope wicking was less damaging to carpet grass.

Figure 3b shows no trend for setaria and an increase in other grasses. Bahia grass, whisky grass and kangaroo grass all increased in the Frenock® treatments.
Patches of bare soil approximately 0.2 m^2 were evident in the boom sprayed treatment, previously occupied by carpet grass.

Figure 3: Effect of boom sprayed Frenock™ on botanical composition



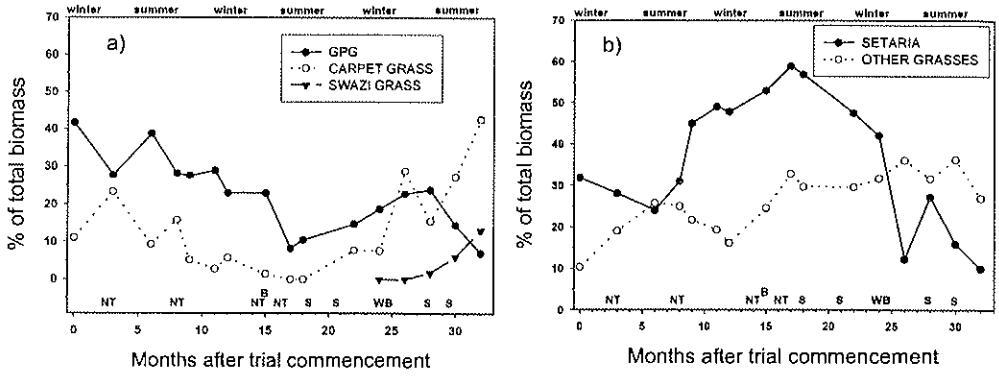
B = cool burn S = slash

It was decided to introduce slashing into these treatments 16 months after trial commencement because the vegetation was tall and rank and did not fulfil roadside objectives.

Non-Tox® treatment
Non-Tox® is a herbicide consisting of concentrated sea salt, potassium permanganate, molasses and an adjuvant. It is aimed at a range of weed control applications where people are "sensitive" to the use of synthetic herbicides.

Figure 4a shows a general decline in the amount of GPG, which reflects the overall downward trend described earlier. Non-Tox® had no effect on any perennial species, however it did control broad leafed seedlings. No comment can be made on Non-Tox®'s effect on GPG seedlings due to lack of recruitment.

Figure 4: Effect of Non-Tox® alternative herbicide, followed by Weedbug™ and planting Swazi grass turf



NT = Non-Tox® application B = cool burn WB = Weedbug™ S = slash

A disadvantage with Non-Tox® is that it requires a prolonged time without rainfall. Synthetic herbicides usually need about 6 hours without rain after spraying, while Non-Tox® should give better results the longer the rain-free period.

Swazi grass and Weedbug™

After 28 months it was decided not to proceed further with Non-Tox®, with the plots being planted with a strip of swazi grass in September 1998, followed by a Weedbug™ treatment the following January. Figure 4a shows the establishment of swazi grass and figures 4a and 4b show respective declines in GPG and setaria following Weedbug™.

Swazi grass is a stoloniferous "soft" grass which competes well with GPG once established.

In trials near Grafton the rate of spread of swazi grass has been very slow under conventional grazing management, as it is attractive to stock. A small paddock at Bellingen planted to swazi turf, which has only been lightly grazed for the last 10 years, showed a greater rate of spread than the Grafton plots.

Swazi grass has potential as a roadside species because maximum height is 30 cm, it is competitive with tussock grasses, and produces little viable seed. This latter point reduces the risk of the species becoming an environmental weed like broad leafed paspalum and its attractiveness to stock limits its threat to grazing land compared with bahia grass.

Addition of superphosphate

The trial site is typical of land where GPG is competitive and dominates under set stocking. Soil has low phosphorus levels (4 ppm Bray) and is acidic with a $pHCaCl_2$ of 4.5. Under these low fertility conditions many species will not compete with GPG.

The objective of adding superphosphate was to observe the effects of increasing fertility on botanical composition.

Initially 20 units of phosphorus (250 kg/ha single super) was applied, however the following soil test showed little improvement in soil phosphorus level, and no effect on botanical composition. In spring 1997 another 20 units of phosphorus (250 kg/ha single super) was added. Soil tests and botanical composition showed no effect. In spring 1998, 40 units of phosphorus (500 kg/ha single super) was added.

In autumn 1999, we are now beginning to see increases in the quantities of white clover in the plus fertiliser plots.

To encourage dominance of desirable species on roadsides, it might be prudent to investigate improving soil characteristics with either lime, gypsum or some form of fertiliser during the road works prior to revegetation. Off target effects such as stream eutrophication, need to be rigorously investigated prior to commencing the amelioration process.

TAKE HOME MESSAGES

- Roadsides must be viewed as vegetation associations influenced by management and not just a place where "noxious" weeds grow.
- Roadside management is a dynamic process and requires staff training and on-going monitoring of conditions and results of actions.
- Roadsides have many stakeholders who may have a wide range of needs and interests in roadsides. Some basic objectives of roadside management must include aesthetics, functionality and safety as well as weed management.
- Slashing of roadsides is an expensive option and not a viable when used alone in high rainfall areas or years. Slashing frequencies required to modify roadside botanical composition will be uneconomic except close to urban areas. Slashing height is often variable due to uneven roadside verge, however the attitude that shorter is better still dominates most roadside managers.
- Rope wicking with glyphosate, in conjunction with slashing, shows the most promise as a system for controlling taller weed species, improving safety and is cost-effective.
- Frenock® is extremely effective at controlling GPG, but lets taller species such as setaria and giant paspalum to dominate. These species are highly undesirable along roadsides.
- Maintaining ground cover is essential to prevent the re-establishment of GPG.
- Before beginning to attempt to modify roadside vegetation, ensure desirable species are present, even in low numbers, and develop management strategies to push the system towards those species. If desirable species are not present they need to be introduced.
- Never have the approach that insists upon the long term objective of GPG eradication, with disregard to other factors. A more realistic objective would be to minimise or suppress the effects of GPG, in an economical, environmental and socially acceptable way.

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BIOLOGICAL CONTROL OF ASTERACEAE WEEDS

Dr Gavin Ash
Farrer Centre
Charles Sturt University
Wagga Wagga

Presenter: Robert Fagan
Generex Distribution Pty Ltd
Tamworth.

Abstract

The basic biology of a fungus (*Phomopsis* sp) isolated from saffron has been studied and the suitability of the fungus as a mycoherbicide has been ascertained. The fungus has been described and characterised using morphological and DNA markers. The environmental conditions required for infection using mycelial inoculum have been defined and preliminary studies on formulation have been completed. The fungus has been found to have herbicidal activity on a range of weeds belonging to the Family Asteraceae. The next step required is to bridge the gap between the basic biology and the application of a commercial mycoherbicide. To do this, the ability of the fungus to produce mammalian toxins must be evaluated, formulation and delivery systems need to be studied and extensive field trials performed. The outcome of this project will be the first commercial mycoherbicide produced in Australia.

Background

There are a number of advantages to the use of mycoherbicides over the use of conventional herbicides, including the minimal residue levels, control of weeds already showing resistance to conventional herbicides, host specificity and reduced chance of resistance to mycoherbicides. This indicates an emerging, strong role for mycoherbicides in any integrated weed management strategy and an important involvement in sustainable farming production systems in the future.

Selected isolates of a pathogen (*Phomopsis* sp) have been found to cause significant damage to saffron thistle and a variety of other weeds in the glasshouse (Crump *et al.*, 1995; 1996; 1997a). Under glass house conditions, inoculations of saffron thistle seedlings, has resulted in death of saffron thistle within 4 days. Inoculations at later growth stages have resulted in destruction of the inflorescence and more typical dieback symptoms preventing seed production. Control of saffron thistle was an exciting result in itself, but the infection of a wide range of weeds belonging to the Asteraceae (Crump *et al.*, 1997a), increases the potential of the development of a commercial product. These include such important weeds as Noogoora Burr, Bathurst Burr, Bitou Bush and Fireweed. Host range studies have also shown that the fungus is virulent on sunflower, safflower and lettuce. This would restrict its use in these crops.

Glasshouse studies have used mycelial inoculum. The environmental conditions required by the pathogen for infection have been defined under glasshouse conditions. Under ideal environmental conditions seedlings were killed within 4 days of inoculation (Crump *et al.*, 1997b). Preliminary experimentation has also been undertaken to determine the effect of formulation on the efficacy of mycelial inoculum. It has been shown that the fungus can be combined with sub-lethal or low rates

of herbicides with no adverse effect on fungal growth. Solid formulation in the form of granules has also been investigated. The fungus can survive long-term storage in this form.

This research is significant, as to date, there have been no successfully commercialised mycoherbicides in Australia. There are a number of reasons for this including restricted host range of some of the candidates, variable field performance of the products and lack of precedence which has restricted the avenues for funding. In this proposal, the candidate organism attacks a range of weeds of economic importance. This improves the chance of producing a mycoherbicide with true market potential. The field performance of the product will be enhanced and made more reliable through the use of a range of formulations including both granular and liquid. The liquid formulation will be improved by the use of novel polymers in conjunction with microencapsulation, which should reduce the impact of the environment on the efficacy of the product. If the project is successful, it will provide the basis and incentive for further projects using similar technologies to be funded in Australia.

The collaboration with Generex Research and Development has developed over the last 12 months not only with the company agreeing to fund this project, but offering advice on its direction and actively pursuing opportunities in formulation and mass production. Generex are committed to this project and are supportive of new projects in similar areas.

The economic benefits from this project could be large in terms of developing a mycoherbicide suitable for Asteraceae weeds. As the research is wholly Australian and the collaborating industry is Australian, the benefits would remain or flow to this country. The experience and knowledge gained from this project will be used in other biological control projects in Australia and will reduce our long-term reliance on traditional pesticides.

Research Plan and Methodology

Initially, field trials in the Wagga Wagga region will be performed on the University farm using populations of the weed sown into the trial. Following the initial trials, more widespread trials will be performed in northern New South Wales, Victoria, South Australia and Western Australia to embrace a range of climatic conditions. These trials will be co-ordinated by the field personnel of Generex Distribution Pty Ltd.

Following these studies, further field trials and toxicology will be conducted to satisfy NRA registration requirements. This will be undertaken by Generex with industry support.

Collaborative Arrangements with Industry

Generex Distribution Pty Ltd is a small, progressive agrichemical company owned by Mr Robert Fagan. It is a wholly Australian owned company, which services winter cereal and grazing pasture areas of New South Wales, Victoria, South Australia and Western Australia. The staff employed by the company are technically competent with many years experience in marketing and the provision of technical support for a variety of agrichemicals.

Due to the company's origins, size and commitment to the Australian agricultural industries, it is ideally suited to the support and utilisation of the research proposed here. The company is committed to the potential for mycoherbicides in Australia and believes, with the proper level of funding, a niche market can be fulfilled.

Take Home Messages

This new method of control of some important Asteraceae weeds comes from Australian research and development at Charles Sturt University.
Generex Distribution Pty Ltd is working with Charles Sturt University to develop this to a marketable product.

Generex Distribution Pty Ltd would like the co-operation and assistance of the Weeds Officers with field and registration trials, when that time comes.
Weed Officers can also assist by collecting any plants of concern in their region that are of concern to their landowners and council and show any unusual disease symptoms.

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HOLISTIC WEED MANAGEMENT

Rebecca Lines-Kelly
Environmental extension coordinator
NSW Agriculture, Wollongbar

Robyn Neeson
Alternative farming systems officer
NSW Agriculture, Yanco

INTRODUCTION

The philosophy of 'holism' believes that the whole is greater than the sum of the parts. Holistic medicine, for instance, maintains that you cannot treat an ache or a pain in the body without looking at the whole person's physical, mental and spiritual wellbeing. Holistic farming looks at the farm as a system, incorporating management of soil, water, vegetation, nutrients, animals and people so that no one aspect dominates to the detriment of the others. Similarly, holistic weed management is not just about getting rid of the weed, but about looking at all aspects of the plant itself, and its role in an ecosystem, and using this information to develop a management plan which will control the weed without damaging the ecosystem. Another term for it is integrated weed management, which may be more familiar.

So how can we integrate holistic weed management with the requirements of the Noxious Weed Act?

Knowledge Of Weed Behaviour

First, we need to know all about the noxious weeds and their behaviour. Weed control tends to focus on the growing or grown weed. Often we know very little about the rest of the life cycle which includes seed germination, seedling survival, growth, flowering, seed production and shed, seed predation and mortality. Weed scientists are becoming increasingly interested in studying weed ecology and populations to work out the best times and ways to control weed growth and spread. Managing weeds when they are only a small problem so that they don't grow into a much bigger problem is vital. It is also important to know the best time to remove weeds so they don't spread seed. Our knowledge of weed behaviour varies according to past experience and research; often we need to find out more.

Range Of Techniques

Second, we need to have a range of control techniques which we can draw on to develop a management plan. As well as herbicides, there many other techniques used to control weeds, mostly developed in farming before herbicides were introduced. Several of them are already used in noxious weeds control and their combined use is known as integrated weed management.

Manual removal

Manual removal is perhaps the most commonly used technique. Weeds in crops are removed by chipping and hand weeding. Larger weeds are dug out when they are not flowering or setting seed

because disturbance at this time may encourage further weed growth. The drawback to this system is that it is laborious, slow and, because it relies on labour, expensive.

Slashing/mowing

Slashing or mowing weeds keeps weeds under control and improves soil fertility. The dead plant parts provide food for soil organisms and earthworms which in turn improve the soil health.

Flame weeding

Flame weeding is effective for some but not all weeds, and requires expensive maehinery to operate.

Hot water/steam weeding

This technique uses fine sprays of very hot water or steam to scald and kill weeds. It has been adopted by some councils for roadside weed control and has potential for more widespread use.

Plant competition

Weeds have been found to be less of a problem in areas with a high level of native biodiversity, so planting with native vegetation may be a useful weed management technique. Shade offered by dense tree canopy can help reduce weeds on roadsides, fence lines and waterways. Excessive clearing and soil disturbance along roadways promote weed growth. On farms, weeds can be out-competed by growing crops with vigorous seedling growth, and crops with broad leaves which can overshadow weed seedlings. Planting different crops that encourage each other (companion planting) or that discourage weeds by exuding chemicals (allelopathy) can also help control weed growth.

Biological control

Insects, fungi and other organisms act as biological control agents by feeding on particular weeds. This is an expanding field in weed management, particularly for the more economically significant weed species. This technique of management does not rely on thc complete extermination of the host weed, but rather the maintenance of a small population which provides an ongoing food source to sustain the control organism.

Cultivation

Cultivation is used to uproot weeds and prepare the soil for planting, but can cause soil erosion and destruction of soil life such as insects and worms which help maintain soil health.

Mulching

Surrounding plants with thick layers of mulch suppresses weeds by blocking out the light.

Weed matting

Weed matting is made from various materials and is designed to block light but allow water and air through. There are concerns about the use of synthetic materials in the matting, and the unsightliness as the matting deteriorates.

Green manure crops

Green manure crops are crops grow to prevent weeds germinating, and then ploughed into the ground while green to improve soil fertility.

Hygiene

Cleaning vehicle tyres and the soles of work boots helps stop the spread of weed seeds.

Each of these techniques is useful in some way for managing weeds. Some of them can also be damaging - for instance cultivation can damage soil structure and encourage erosion. Many of the techniques are used in conjunction with herbicide, instead of herbicide alone, to reduce the possibility of herbicide resistance. In fact, herbicide resistance has stimulated use of holistic weed management strategies on farms and these strategies have helped the farms become more sustainable and even more profitable. (Powles 1997) The strategies and techniques chosen will depend on the behaviour and extent of the weed. Holistic weed management 'uses all available methods to best advantage, avoiding reliance on any one method. Each method has some negative aspect and is ultimately unsustainable - ecologically and/or economically - on its own.' (Kristiansen 1999a)

The concept of holistic or integrated weed management is not new. It was used before the introduction of herbicides and has been an important concept in weed management in recent years. It is one of the platforms of NSW Agriculture's weed management strategy. *The Australian Weed Control Handbook* supports it strongly but provides little practical information, which indicates the relative lack of research in this area. There are currently some research studies being conducted, some of them within NSW Agriculture as part of the department's commitment to reduce pesticide and herbicide use. (Kristiansen 1999b) As information becomes available from these research projects it needs to be distributed widely through weed management networks.

HOLISTIC WEED MANAGEMENT IN ORGANIC FARMING

Holistic weed control is particularly useful when controlling weeds in areas where herbicides cannot be used - for instance in council areas where herbicides are banned, and on organic and biodynamic farms. These farming systems ban the use of synthetic compounds such as pesticides and herbicides because the farms are designed to mimic the natural ecosystem as much as possible. For this reason, organic farmers do not see weeds as enemies to be annihilated, but as plants within the ecosystem. For instance, weeds can indicate and improve soil conditions and provide habitats for beneficial species. However, organic farmers still need to abide by the Noxious Weeds Act, so have to look at techniques other than herbicides to manage noxious weeds. The difficulty of controlling weeds without herbicides makes weed management a major constraint in organic and biodynamic agriculture, although more experienced growers find them less of a problem than newer growers.

It is important that weeds officers support organic farmers in their weed management. The organic approach is fast gaining world-wide approval. People are increasingly concerned about pesticide residues in their food and in the air and soil around them, and do not trust reassurances given by government departments and the chemical industry. As a result, the clean green image is a

profitable marketing tool. TradeNZ estimates that the world market for organic produce will exceed $5.8 billion by 2000. Australia has established niche markets for its organic produce in the European Union, USA, Japan, Singapore and Hong Kong. It has been able to do this because organics has internationally recognised accreditation systems. The National Standard for Organic and Biodynamic Produce sets out minimum requirements for production, processing and labelling of organic produce, and requires producers and processors to be certified with an accredited industry organisation. Each organisation is audited annually by the Australian Quarantine Inspection Service to ensure it meets the national standard. The six organisations currently accredited are listed in Appendix 1. As well, pesticide residues are being used as a non-tariff barrier to trade. Countries throughout SE Asia and Europe are introducing sophisticated residue monitoring processes for food imports. In recognition of the importance of organic and similar holistic methods of production, NSW Agriculture employs an alternative farming systems officer and has established an organics network.

The organic philosophy of weed management can be summarised in four principles.
* Weed elimination is not the goal as this disrupts the ecological system.
* Weeds are our teachers - our challenge is to address the causes and not the symptoms.
* We need a variety of management techniques to manage weeds.
* Any weed management strategy has both positive and negative impacts on other parts of the system and these need to be considered when designing the strategy. (Oien, 1999)

These principles are very similar to those used in holistic management, except that the latter uses careful applications of herbicide as well. When looking at control of noxious weeds on organic farms, it is helpful if weeds officers can discuss the different techniques with the farmers to develop a management strategy using some or all of the techniques described earlier. Such consultation improves communication and promotes exchange of information by both weeds officers and landowners to achieve their common aim - control of weeds.

If we are to manage noxious weeds, holistic weed management is the way to go. It enables us to manage weeds by understanding their behaviour and knowing the full range of techniques available for control. Holistic management fits weed control into the natural cycle so that it interferes as little as possible with other aspects of nature- soil, water, air, plants, animals and humans.

TAKE HOME MESSAGES

1. Know as much as possible about the weed and its behaviour - how it grows, where it grows and why it grows there - to develop the best techniques to keep it under control.
2. Use a variety of management techniques to control any weed. Don't rely on just one method.
3. Work with landholders to develop management techniques that suit the particular situation.

ACKNOWLEDGEMENTS
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Appendix 1

Accredited organic organisations as at September 1998

Bio-Dynamic Research Institute POWELLTOWN VIC 3797	Phone 03 5966 7333 Fax: 03 5966 7433
Biological Farmers of Australia Co-Operative Ltd PO Box 3404 TOOWOOMBA VILLAGE FAIR QLD 4350	Phone 07 4639 3299 Fax: 07 4639 3755
National Association for Sustainable Agriculture (Australia) Ltd PO Box 768 STIRLING SA 5152	Phone 08 8370 8455 Fax: 08 8370 8381
Organic Herb Growers of Australia Inc PO Box 6171 SOUTH LISMORE NSW 2480	Phone and Fax: 02 6622 0100 email: herbs@om.com.au
Organic Vignerons Association of Australia Inc 1 Gawler Street (PO Box 503) NURIOOTPA SA 5355	Phone 08 8562 2122 Fax: 08 8562 3034
Eco-Organics of Australia (tea tree oil only) PO Box 198 CORAKI NSW 2471	Phone: 02 6683 2740 Fax: 02 6683 2814 After hours: 02 6683 2815
Organic Food Chain PO Box 2390 TOOWOOMBA QLD 4350	Phone and Fax: 076 372 600

More information on the production and marketing of Australian organic produce can be obtained by contacting the Organic Federation of Australia at the address below:

Organic Federation of Australia c/o 452 Lygon Street EAST BRUNSWICK VIC 3057	Phone: 03 9386 6600 Fax: 03 9384 1322 E-mail: ofa@netspace.net.au

WEED MANAGEMENT COMPETENCIES

Richard J Carter
Program Leader (Weeds)

BACKGROUND

There are many training programs on offer which provide skills needed for weed management staff of control authorities. Unfortunately the majority of training programs available focus on base level skills. Most spray operators have completed the Farm Chemical Users Training Program. We have almost all completed some form of conflict resolution training. There are numerous trainers who run courses to meet these general needs. Most of this training is at Australian Qualification Framework (AQF) level 2 (see table 1). The more advanced skills we possess or would like to have are not well catered for in NSW. We work in a technologically advanced area.

The NSW Weeds strategy included "*Establish competency standards required for different staff involved in noxious weed control programs and develop curricula for appropriate training courses*". This was included to recognise what many of us have been looking for.

Australian Qualification Framework (AQF)

To understand competencies and how it relates to training a basic understanding of the Australian Qualification Framework is needed. The framework provides a structure for relating work skills and the level of training. It works across all vocational training in Australia. There are eight levels, with the first being the untrained entry level, and the eighth not being used at this stage. They are not evenly spaced in terms of skills, but generally relate to tertiary qualification levels as is shown in the table 1.

Weed Management Competencies

Now not only do we have competency standards for NSW, but we the National Weed Management Competency Standards are now nearing reality. The Standards document the skills, knowledge and aptitude needed for the full range of tasks carried out by weed control staff, from assistant Operators to Weed Inspectors and Chief Weed Officers. The standards, enable the training providers such as TAFE, NSW Agriculture or anyone else to design training programs. Some of the skills are basic, but others are at the AQF level 6.

Over 12 months ago all states agreed to pursue the goal, and largely due to the efforts of David Hislop this is now achieved. The process involved the establishment of a national steering committee and state consultative groups. In NSW we established two tiers of consultation. A core group who we invited to a workshop of peak bodies, and a second tier who provided comment on draft documents available from the National Weeds Strategy web site.

Table 1 AQF Work levels and Australian Qualification Framework Levels

WORK LEVEL AND AQF	WORK LEVEL DESCRIPTION
Work level 1 Certificate I	• work is under direct supervision with regular checking • involves a limited range of tasks and roles • competencies are used within established routines, methods and procedures that are predictable
Work level 2 Certificate II	• work is under routine supervision with intermittent checking or general guidance • may involve responsibility for some roles and coordination in a team • involves range of tasks and roles • competencies are used within established routines, methods and procedures that require some discretion and judgement
Work level 3 Certificate III	• work is under limited supervision with checking on overall progress or broad guidance • may include responsibility for the work of others and team coordination • involves depth of knowledge in some areas and a broad range of skills • involves a broad range of roles in a variety of contexts • competencies are used within routines, methods and procedures that require discretion and judgement in decision making
Work level 4 Certificate IV	• work without supervision with general guidance on progress and outcomes • may involve supervision of and organisation of work of others • depth of knowledge in some areas and broad range of skills • involves a wide range of tasks and roles and a broad range of contexts • complexity in the range and choice of actions • competencies are used within routines, methods and procedures that require discretion and judgement in decision making for self and others
Work level 5 Diploma	• work is under broad guidance • may involve responsibility for planning and work of others • involves the self-directed application of knowledge with substantial depth in some areas and a range of technical and other skills • involves a wide range of tasks and roles in both varied and highly specific contexts • competencies are used independently and both routinely and non-routinely • judgement in decision making for self and others
Work level 6 Advanced Diploma	• work is under limited guidance in line with a broad plan, budget or strategy • involves responsibility and accountability for management and work of others • involves the self-directed development of knowledge with substantial depth across a range of areas and/or a range of specialised technical and other skills • involves application of knowledge and skills to major functions in either varied or highly specific contexts • competencies are used independently and are substantially non-routine • significant judgement in decision making for self, others and the organisation

As the standards relate to existing skills, aptitudes and knowledge, people currently in the field may not need specific training. Weed officers skills can be recognised by employers more readily. Their weed management skills can be compared to the engineering or accounting department.

We hope that the competencies will become part of a national training package incorporating other land management disciples such as vertebrate pests, bush-regeneration, landcare and conservation earthworks.

In the future we will try to ensure that training NSW Agriculture offers comply with these standards. It may mean that when we offer training we may need to include optional assessment

Following in table 2 is a summary of the units of competence included in the draft competencies at the time of preparation of this paper (May 1999). The full set is available on the web (http://www.weeds.org.au/ncwc.htm).

NSW TAFE are already preparing new material as part of Certificates II and IV in Weed Control which will meet some of the standards. The NSW Police Academy is considering delivering training to meet the range of skills needed to implement legislation. In the Castlereagh -Macquarie and Lachlan Valleys local control authorities are already training staff using these competencies.

There is now the scope for weed officers to get the recognition you deserve. It is now up to you to use them.

TAKE HOME MESSAGES

The competencies are now available. If seeking training for yourself or your staff check that it meets these standards. If employing staff the standards will help you define what skills, aptitude and knowledge you are looking for.

ACKNOWLEDGEMENT

The National Weeds Competencies were developed by NSW Agriculture with assistance from the Natural Heritage Trust. On behalf of the National Steering Committee I wish to acknowledge the effort put in by all those who provided competencies used by councils, attended workshops, waded through the draft competencies and made useful comment.

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Table 2 IDENTIFICATION OF WEED MANAGEMENT UNITS WITHIN THE AUSTRALIAN QUALIFICATIONS FRAMEWORK–LEVELS AQF1–AQF6

Unit of competence	Unit Title	AQF 1	AQF 2	AQ 3	AQ F 4	AQF F 5	AQF 6
RUH CORE1 A	Meet industry requirements	MANDATORY					
RUH CORE2 A	Meet workplace health and safety requirements						
RUH CORE3 A	Use hazardous substances safely						
RUH CORE4 A	Cooperate in the workplace						
RUH CORE5 A	Act in an emergency						
RUH CORE6 A	Plan daily work routines						
WEM100	Remove weeds	✓					
AG110EO A	Operate equipment	✓					
WEM200	Report listed plants or new occurrences		✓				
WEM208	Inspect equipment for plant and soil material		✓				
WEM209	Clean equipment for plant and soil material		✓				
WEM210	Participate in weed management planning and evaluation activities		✓				
WEM206	Work within legislative requirements		✓				
WEM209	Communicate in the workplace		✓				
WEM210	Apply chemical and biological agents		✓				
WEM211	Record electronic data		✓				
WEM212	Deal with conflict		✓				
AG2005CH	Maintain supplies of chemicals and biological agents		✓				
AG2100EO	Operate ride-on vehicles		✓				
AG2102EO	Operate tractors		✓				
RUA AG2007CH A	Prepare chemicals and biological agents		✓				
RUA AG2010CH A	Clean up following application of chemicals and biological agents		✓				
RUH HRT201 A	Treat weeds		✓				
RUH HRT204 A	Communicate in the workplace		✓				
RUH HRT212 A	Apply chemicals and biological agents		✓				
RUH HRT213 A	Fell small trees		✓				
RUH HRT222 A	Operate and maintain chainsaws		✓				
RUH HRT237 A	Support revegetation works		✓				
WEM301	Control weeds			✓			
WEM302	Assist in the implementation of legislation			✓			
WEM303	Inspect management area for weeds			✓			
WEM302	Assist in the implementation of legislation			✓			
WEM303	Inspect management area for weeds			✓			
WEM307	Collect, prepare and preserve plant specimens			✓			
WEM308	Assist in defining the weed problem in a local area			✓			
WEM309	Assist in developing a strategy for the management of target weed(s) within a local area			✓			

WEM310	Use and prepare maps			✓			
WEM311	Monitor the local weed management strategy			✓			
WEM312	Identify and report plants			✓			
WEM313	Release biological agents			✓			
WEM314	Maintain biological cultures			✓			
RUH HRT316 A	Control weeds			✓			
RUH HRT325 A	Supervise work site activities			✓			
RUH HRT328 A	Operate specialised machinery			✓			
RUH HRT329 A	Operate machinery in adverse conditions			✓			
RUH HRT331 A	Maintain an office			✓			
RUH HRT352 A	Implement an integrated pest management program			✓			
RUH HRT353 A	Select chemicals and biological agents			✓			
RUA AG3021OH	Implement occupational health and safety policies and guidelines			✓			
WEM400	Implement weed management action plans				✓		
WEM402	Develop a strategy for the management of target weed(s) within the local area				✓		
WEM403	Design calibration procedures				✓		
WEM404	Develop monitoring procedures for the local weed management strategy				✓		
WEM405	Produce maps for management of a weed problem				✓		
WEM406	Coordinate the local weed management strategy				✓		
WEM407	Investigate treatment failure				✓		
WEM408	Define the weed problem in a local area				✓		
RUH HRT401 A	Plan revegetation works				✓		
RUH HRT403 A	Source information				✓		
RUH HRT412 A	Develop an integrated pest management program				✓		
RUH HRT417 A	Deliver on the job training				✓		
RUH HRT418 A	Supervise staff				✓		
RUH HRT419 A	Supervise machinery maintenance				✓		
RUH HRT421 A	Supervise supplies and services				✓		
RUH HRT425 A	Maintain systems of communication				✓		
RUH HRT426 A	Develop teamwork				✓		
RUH HRT432 A	Manage and notify a chemical spill and/or leakage				✓		
RUH HRT435 A	Cost a project				✓		
RUA AG420BM A	Operate within a budget framework				✓		
RUA AG4021BM A	Establish and maintain the enterprise OHS program				✓		
RUA AG521BM A	Conduct land management practices in concert with existing ecosystems					✓	
RUH HRT506 A	Negotiate with clients and others					✓	
RUH HRT512 A	Prepare and monitor budgets and financial reports					✓	
RUH HRT513 A	Manage business operations					✓	
RUH HRT514 A	Administer the business					✓	
RUH HRT522 A	Collect and manage data					✓	
RUH HRT523 A	Trial products and treatments					✓	
RUH HRT528 A	Prepare reports					✓	

RUH HRT529 A	Manage weed, pest and disease infestations					✓	
RUH HRT529 A	Conduct vegetation surveys					✓	
WEM504	Define the weeds problem in a regional or broader context					✓	
WEM505	Develop a strategy for the management of target weed(s) within a regional or broader context					✓	
WEM506	Design a system for monitoring the weed strategy in a regional or broader context					✓	
WEM507	Evaluate the weed management strategy in a regional or broader context					✓	
WEM508	Coordinate the weed management strategy on a regional or broader context					✓	
WEM509	Manage the implementation of legislation					✓	
RUH HRT601 A	Develop staff training plans						✓
RUH HRT602 A	Develop a business plan						✓
RUH HRT604 A	Manage human resources						✓
RUH HRT607 A	Manage business capital						✓
WEM600	Contribute to weed management policies						✓
LGC01	Develop group operating processes						✓

COLLECTION OF EVIDENCE, INTERVIEWS AND THE EVIDENCE ACT (1995)

Philip Blackmore
Noxious Plants Advisory Officer
NSW Agriculture
Armidale

INTRODUCTION

Prosecutions are expensive to conduct and the community is not well served by the initiation of flawed or unwarranted legal action. This makes the proper collection of evidence of utmost importance when legal action may be a possibility. One of the most important methods of collecting evidence is the interview. When investigating a possible offence under the Noxious Weeds Act every effort should be made to interview the person or people concerned. In fact, when a person who is the subject of any legal action has not been interviewed, the matter has not been properly investigated.

Evidence from observations made by an inspector or another person and from documents is of great importance in building a prosecution case. However, if this evidence does not prove all the elements of the offence, the brief is not complete. A prosecution brought on the basis of incomplete evidence will almost certainly fail.

An interview may reveal important facts about an occupier of land or a vendor of plants that cannot be established by observation or documentary evidence. The interview might also reveal that the person has a reasonable excuse. The last place that you want to discover that the defendant has a legitimate defence, is in court !

COLLECTION OF EVIDENCE

(From Collection of Evidence - Notes for Legal Training Seminar - Stage 2, Legal Branch, NSW Agriculture)
The initial evidence of a possible offence under the Noxious Weeds Act will usually come from your own observation in the course of your duties as an inspector. However you may also receive information from the observation of another person. To establish that an offence has been committed you must prove **all** of the elements of the offence.

Elements of Offences
The first step of any investigation is to identify what has to be proved. To do this you must examine the section of the Act that provides for the particular offence and identify each element of the offence. You should also examine the Dictionary Of Words And Meanings to be aware of the specific meaning of words as used in the Act. For example an offence under Section 19 of the Noxious Weeds Act 1993 has 5 elements of the offence:

1. An occupier of land
2. other than a public authority or local control authority
3. given a weed control notice

4. by a local control authority
5. must not fail to comply with the notice

Proofs for Elements of Offences
The second step in investigating a possible offence is to work out how to prove each of the elements of the offence. There are three types of proofs which you may collect to prove each element of an offence.

1. OBSERVATIONS - made by yourself or another person
2. DOCUMENTS - the contents of which prove facts
3. ADMISSIONS - made by the defendant in the course of an interview.

Only after you have identified the type of evidence which may be available to prove each element and who may be available to provide that evidence, will you be in a position to collect the necessary evidence to prove the offence. Thorough preparation will lay the foundation for a systematic collection of evidence on all available proofs for each element of an offence.

INTERVIEWS AND THE EVIDENCE ACT (1995)

The purpose of conducting an interview is to collect evidence in the form of statements made by a witness or by admissions from the defendant that may help to prove, or disprove, the elements of the offence. However you should not rely solely on admissions to prove all of the elements of the offence. When conducting an interview with a possible defendant you should be aware of the provisions of the Evidence Act 1995. Section 138 (1) (a) of the Evidence Act states that evidence that has been illegally or improperly obtained is not admissible in court.

Further, Section 139 (2) states that :

For the purposes of Section 138 (1) (a), evidence of a statement made or act done by a person during official questioning is taken to have been obtained improperly if :

a. the questioning was conducted by an investigating official who did not have the power to arrest the person, and

b. the statement was made, or the act was done, after the investigating official formed a belief that there was sufficient evidence to establish that the person has committed an offence, and

c. the investigating official did not, before the statement was made or the act was done, caution the person that the person does not have to say or do anything but that anything the person does say or do may be used in evidence.

This means that, any admissions made by a person in the course of an interview conducted by an inspector, after the inspector had (or should have) formed a belief that there was sufficient evidence to establish that the person had committed an offence, will be deemed to have been improperly obtained and therefore inadmissible, if the inspector did not, at that time, caution the person as to their right to not answer questions.

In the course of a interview in relation to a possible breach of Section 19 of the Noxious Weeds Act, when might an inspector be able to form a belief that there was sufficient evidence to establish that the person had committed an offence ?

When investigating a possible offence, nothing should be presumed. Therefore, having a gut feeling is not the same as forming a belief that there is sufficient evidence to establish that the person has committed an offence. NSW Agriculture Legal Branch has received advice that cautioning should take place:

i. if you are in doubt about whether you have sufficient evidence to establish that the person has committed an offence, and

ii. if you have a **reasonable suspicion,** (i.e. a suspicion based on evidence), that the person has committed an offence.

As a general rule it is better to caution too early than too late.

The caution should be delivered verbatim. It is as follows:

I am going to ask you some further questions.
I am going to caution you because I believe that there is sufficient evidence to establish that you have committed an offence.
You do not have to say or do anything but anything you do say or do may be given in evidence.
Do you understand what I have said?

How would the systematic approach to collection of evidence and the constraint of the Evidence Act be applied in the field ?

COLLECTION OF EVIDENCE - WHERE AN OCCUPIER DOES NOT APPEAR TO BE CONTROLLING NOXIOUS WEEDS

Weed Control (Section 18) Notices

In the course of re-inspecting a property an inspector may form an impression that the occupier has not met their obligations to control noxious weeds. The inspector may feel that the issue of a Section 18 notice may be appropriate. However an LCA must have proper grounds to give an occupier a Section 18 notice. This should be carefully investigated. In the event of any subsequent action against the occupier for failure to comply with the notice, your prosecution may be dismissed if a magistrate were to find that your LCA had not established that it had proper grounds to issue the notice.

The Proper Grounds for the Issue of a Weed Control Notice

An LCA may only give an occupier a Section 18 notice (a weed control notice) if satisfied that the occupier has failed to carry out any of the occupiers obligations to control noxious weeds, (Section 18 (3)). Therefore, before a notice can be issued, you must establish:

1. that the person with whom you are dealing is the occupier of the property on which you have found the weed, and

2. the occupiers full name and address, and

3. that the weed is noxious in your LCA area, and

4. that the weed is growing on the occupier's property, and

5. that the location where the weed is growing on the occupier's property is within your LCA area, and

6. that the weed has not been controlled in a manner consistent with the declared control category.

Proofs to some of these elements may be obtained by interviewing the person whom you presume to be the occupier. Questions should always be short, to the point and not double barrelled. Answers to your questions should be recorded in writing during the interview or immediately afterwards. When reporting the facts of an interview to your supervising officer, the interview should be recorded in the form of "I said", "He said". Before commencing an interview you should have your authority card ready to hand in case the interviewee asks to see it and then say:

"My name is (state your full name), I am an inspector under the Noxious Weeds Act for the (the name of your LCA). I would like to ask you some questions about weeds on this property."

Element 1 may be established at interview by admission. Note that the element "an occupier of land" has a number of sub-elements due to the meaning as defined by the Noxious Weeds Act. Each of the sub-elements must be proved. The Noxious Weeds Act defines **occupier of land** as:

a. the person for the time being entitled to possession of the land and includes, if the persou so entitled does not reside on the land, the resident manager or other person in charge of the land.

Examples of questions which could be used to establish that the person with whom you are dealing is the occupier of the land include:

- Are you the owner of (the name of the property) ?
- (Backup question) Who pays the council rates for (the name of the property) ?
- Do you live on (the name of the property) ?
- (if no) Does a manager live on (the name of the property) ?
- Are you in charge of the management of (the name of the property) ?
- Is any part of (the name of the property) leased to anybody else ?
- Is any part of (the name of the property) under the control of another person or organisation ?
- Would you agree that you are in possession and control of (the name of the property) ?

You should later check the rates records for the description of the ownership of the property.

Element 2 should be established by direct question.

- Could you state your full name and address please ?

You should confirm this against rates records and the electoral roll.

Element 3 In the case of weeds which have clear identifying characteristics, such as St John's Wort, your own expertise should be sufficient. However for a weed for which there may be some doubt with regard to identification, such as giant Parramatta Grass or Johnson Grass, formal identification from the state or regional herbarium should be obtained.

Collecting a sample of the weed and taking it to the herbarium must be done carefully and precisely. The sample must be carefully labelled and placed into a tamper proof container. It is then preferable that you deliver the sample to the botanist personally. However, if this cannot be done the chain of possession must be precisely documented right up until the sample is placed into the hands of the botanist at the herbarium. There should not be any events which suggest that he sample has been tampered with along its journey.

Element 4 May be established at interview by admission. Where the weed is widespread across the property, this should not be difficult.

- This weed is St John's Wort. Do you agree that this weed is growing on (the name of the property)?

However where the occupier declines to accompany you to inspect an isolated infestation, other means will have to be employed. For example you may take a GPS reading and then plot the point on a large scale topographical / cadastral map.

Element 5 Is of particular importance where the property is close to the LCA boundary, (Section 41(3)). This may also be established with a GPS and a topographical map.

Element 6 May be established by your own observation, which should be recorded in writing and may be supported using photographs or video recording. You may ask the occupier what work he has done to control the noxious weed.

- Have you sprayed the St John's Wort infestation that I advised you about on (date of last inspection) ?
- (If yes) When was this work done ?
- What herbicide did you use ?
- At what rate was the herbicide applied ?
- (If no) Has anyone else sprayed the St John's Wort for you.

If the occupier says that the work has not been done, **do not ask any further questions at this stage.** Thank the occupier for his time and leave the property.

Serviee of Weed Control Notices

Section 71 proscribes methods by which a notice may be served. At a Legal Training Seminar, Mr Alan Russell, formerly Chief Legal Officer of NSW Agriculture advised Agricultural Inspectors at the seminar that notices should preferably be served in person. He said that other methods of service should be used only if it was not possible to serve the notice in person and then, in the order in which the methods were listed in the Act.

Many councils serve notices by registered mail. This has several disadvantages. In many rural areas mail deliveries are only made on two or three days of the week. The recipient then has to collect the

notice from the post office when they are next in town. This means that the time limit on the notice may be much longer than is desirable. Also if someone other than the occupier collects the notice, the occupier may deny having received it. Even when the notice is registered for personal collection only, an artful occupier may not collect it from the post office.

When serving a notice, the inspector should attempt to explain the requirements of the notice to the occupier. The inspector should then ask the occupier if they have understood what has been said. It is recommended that the inspector be accompanied by an assistant when serving a notice personally.

FAILURE TO COMPLY WITH A WEED CONTROL (SECTION 18) NOTICE

During the re-inspection of the property after the notice has been served, if it is observed that the notice might not have been complied with, you should gather evidence to prove the elements of the offence.

The Noxious Weeds Act - Section 19
An occupier of land (other than a public authority or a local control authority) given a weed control notice by a local control authority, or a successor in title who has notice of the notice, must not fail to comply with the notice.

Observations
Initially, observations of the noxious weed infestation should be made. These observations should be recorded as notes as well as photographs or even video recording. Notes should include reference to the apparent health of the plants, the lack of any symptoms of herbicide injury, the lack of any wheel tracks that would be consistent with boom spraying etc.. Photographs should include a sign showing the name of the weed, the property and the date. When composing your photographs try to include, if possible, a landmark or feature that helps to identify the location.

The next part of your investigation will be to interview the occupier.

Interviewing the Occupier
In order to collect evidence by way of admissions to prove the elements of the offence, the interview will be based on five general groups of questions. To recap, the elements of the offence are:

1. An occupier of land
2. other than a public authority or local control authority
3. given a weed control notice
4. by a local control authority
5. must not fail to comply with the notice

Proofs for a number of these elements will have been established earlier in the investigation. This does **not** mean that they can be ignored. The interview should aim to confirm these proofs.

The six groups of questions are:

The occupier should be cautioned as to his / her right to silence at this point.

1. the name and address of the oecupier of the property,

2. that the interviewee is the oecupier of the property described in the Section 18 notice,

3. that no part of the land in question is under the control of a public authority or council

4. that the occupier received the notice,

5. that the occupier understood the requirements of the notice.

6. that the occupier has failed to comply with the notice.

A seventh group of questions should also be asked to establish whether the occupier had any reason for failing to comply with the notice. This is not an element of the offence but may help to determine any subsequent actions by the LCA.

You should caution before the iuterview commences.
You will have previously established that the interviewee is the occupier and the occupiers name and address. If the notice was served in person you will know that the occupier received the notice. If the notice was served by person to person registered mail and you have received the collection receipt, you will also have established that the occupier received the notice. This evidence, in combination with your observations in the field, should enable you to form an opinion that there is sufficient evidence to establish that the occupier has committed an offence. Therefore before the interview commences, you should caution the person as to their right to silence. If you do not, this whole interview may be ruled inadmissible!

The following questions might be used in an interview to obtain admissions to prove the elements of the offence:

Element 1a
- I would like to confirm that your name and address is .....

Element 1b
- Since our conversation on (date of the first interview) are you still in charge of the management of (property name) ?
- Has (property name) been leased to anybody ?
- Has (property name) been sold ?
- Is any part of (property name) of under the control of any other person or organisation ?
- Would you agree that you are currently in possession and control of (property name) ?

Element 2
- Is any part of (property name) of under the control of a government or council body ?

Element 3a

- This is a copy of a Weed Control Notice addressed to you and dated (the date the notice was signed by the GM). Do you agree that you were given (mailed) the original copy of this notice ?
- Do you agree that you were given (collected from the post office) the original copy of this notice on (date) ?
- (If denies receiving notice by mail) This is your name on the registered mail collection receipt for the notice. Is this your signature ?

Element 3b

- Did you understand what the notice required you to do ?
- Did you understand when the work required by the notice was to be completed ?
- (If no and the notice was served in person) When you were given the notice, the requirements of the notice were read to you. You were then asked if you understood what had been said to you and you said that you did. A witness has stated that this happened. What do you say about that ?

Element 4

Proof that you are within the boundary of your LCA was established prior to the issue of the notice. No further proof of this element is needed.

Element 5

- Have you done the work required by the Weed Control Notice ?
- (If yes) When did you do the work ?
- What chemical did you use ?
- At what rate did you apply the herbicide ?
- What spray equipment did you use ?
- Where did you buy the chemical ?
- What did you do with the chemical drum ?
- (If no) Has anyone else done the work on your behalf ?
- (If yes to this question) Who was it ?

Element of Mitigation 6

- Is there any reason why you have not done the work ?
- (If too sick, too busy or too lazy, the sprayer is busted & can't get the parts or can't get the chemical or haven't got a sprayer) Is there any reason why you could not have arranged for someone else to do the work ?
- (If too wet, too dry, too windy or too impecunious) Is there any reason why you did not advise the LCA that there were factors beyond your control that would prevent you from doing the work?

When you have concluded the interview, advise the occupier that this is a serious matter and that you will be reporting it to the General Manager. Then leave the property. You should then write a report to the GM, stating the facts of the matter and make a recommendation for action.

TAKE HOME MESSAGES

- If you have not done Stage 2 or Stage 3 Legal Training Seminars advise your NPAO / RWCC.
- Before commencing an investigation, determine the elements of the offence
- and the types of proofs that you will need to prove those elements.

- During an interview, if you have a **reasonable suspicion** that the person has committed an offence, administer the caution.
- You can't establish that a person is an occupier from documentary evidence alone.
- Serve notices in person.
- When investigating a possible offence, **never presume anything.**
- A properly conducted investigation may not be a guarantee of success in court but a poorly conducted investigation **will be a guarantee of failure.**

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Advice on the collection of evidence and the application of section 139 of the Evidence Act from the following people has been greatly appreciated:

Ms Barbara Jones, Senior Legal Officer, NSW Agriculture, ORANGE

Mr Rod Blackmore, formerly Senior Magistrate of the Children's Court of NSW, SYDNEY

Mr Brian O'Connell, Chamber Magistrate. Court House, ARMIDALE

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BIOLOGICAL CONTROL OF ENVIRONMENTAL WEEDS IN NEW SOUTH WALES

Royce H. Holtkamp
Senior Entomologist
Weed Biological Control Unit &
CRC for Weed Management Systems
RMB 944 Calala Lane
Tamworth NSW 2340

INTRODUCTION

Research into biological control of weeds has been carried out in Australia since early this century. For many years emphasis was on controlling weeds of agricultural significance. This philosophy was based on the fact that benefits were obvious in agricultural situations. Because of this philosophy and the difficulty in placing a dollar value on the environment, biodiversity and aesthetics, biological control of environmental weeds was largely ignored. However, in recent times, the desire of modern man to "get back to nature" has seen a renewed interest in preservation of the environment. As a consequence, there are now a number of biological control campaigns against environmental weeds in Australia. This paper provides details on some of those applicable to New South Wales.

TARGET WEEDS

Bitou bush

Bitou bush, *Chrysanthemoides monilifera* subsp. *rotundata*, a native of South Africa, was extensively used in Australia during the early 1950's as a sand stabilising plant and to revegetate coastal areas mined for mineral sands. It is now a serious weed of conservation areas. In invaded vegetation, plant diversity is reduced with a subsequent detrimental effect on native fauna. It is restricted to areas of summer rainfall and infests coastal areas of southern Queensland, New South Wales and Lord Howe Island. There is also a localised infestation at Menindee Lakes in far western New South Wales. In New South Wales it is common in areas north of Sydney and occurs south to the Victorian border. Bitou bush was first recorded in Australia from Stockton near Newcastle in 1908 where it appears to have been an accidental introduction in ships ballast.

A biological control program against *C. monilifera* (bitou bush and the closely related sub-species boneseed) commenced in 1989 and seven species of insects have been released with additional species (including a pathogen) under investigation. Host specificity testing for *Chrysanthemoides* insects is being conducted at Keith Turnbull Research Institute, Victoria while pathogen testing is taking place at CSIRO, Canberra.

Insects imported are bitou tip moth, *Comostolopsis germana*; five species of leaf feeding beetle: black boneseed beetle, *Chrysolina* sp. 1, blotched boneseed beetle, *Chrysolina picturata*, painted boneseed beetle, *Chrysolina* sp. 2, *Ageniosa electoralis* and bitou tortoise beetle, *Cassida* sp.; two species of seed flies, *Mesoclanis polana* and *M. magnipalpis*; a leaf feeding moth, *Tortrix* sp. and an eriophyiid mite, *Aceria neseri*. The pathogen is a rust fungus, *Endophyllum osteospermi*. The seven species

released to date are *C. germana*, *Chrysolina* sp. 1, *C. picturata*, *Chrysolina* sp. 2, *Cassida* sp., *M. polana* and *M. magnipalpis*. These species only develop on *Chrysanthemoides* spp. *A. electoralis* was able to develop on a number of plant species and has been rejected as a possible biological control agent. *Tortrix* sp., *A. neseri* and *E. osteospermi* are still undergoing quarantine host specificity testing.

Of the species released in Australia, *C. germana* and *M. polana* have been the most successful. *C. germana* has been released at over 70 sites in New South Wales. It is now established along most of the New South Wales coast and it is believed that this insect has spread throughout all bitou bush infestations although its numbers are still increasing in some areas. In many areas, it is having a significant impact on flowering and seed production of bitou bush. Experiments are currently underway to quantify the impact of *C. germana*. Preliminary results indicate populations in excess of 400 larvae/m^2 can occur. High populations have reduced seed production by over 50% at some sites. *M. polana* was first released in very low numbers in August 1996 at Iluka Bluff and Dunbogan. Since this, nine releases have been made on the New South Wales North Coast. By August 1998, *M. polana* had been found from Noosa Heads in Queensland to Tathra in southern New South Wales, a total of over 1200km of coastline. Over much of this area, population levels are extremely high and reductions in seed production of 50% are common. Further experiments on this species are continuing.

Chrysolina sp. 1 and *Chrysolina* sp. 2 have each been released at several sites in New South Wales. Neither species has established at any of these sites. *C. picturata* will not be released in New South Wales as it is specific to boneseed and prefers winter rainfall areas found in Victoria and South Australia. Releases of *Cassida* sp. are continuing on the North Coast and populations are persisting at these sites. *M. magnipalpis* has recently been released onto boneseed in Victoria and South Australia.

Lantana

Lantana, *Lantana camara*, is a significant weed of coastal and sub-coastal eastern Australia from Cape York, Queensland to Mt Dromedary, NSW. It is also present in the Northern Territory and Western Australia. It invades national parks reducing biodiversity, as well as forestry and grazing areas, where it decreases pasture production and poisons cattle and sheep. Biological control of *L. camara* has been conducted in Australia since 1914 and 28 agents have been introduced with 17 species establishing, although only four appear to cause significant damage.

The principal agents damaging lantana in Australia are the leaf-mining beetles *Octotoma scabripennis* and *Uroplata girardi*, the sap-sucking bug *Teleonemia scrupulosa* and the seed fly *Ophiomyia lantanae*. A stem-sucking bug, *Aconophora compressa*, and a leaf-feeding beetle, *Alagoasa parana*, are currently being reared and released in NSW and cooler regions of Queensland. First generation insects have been located at a number of sites but it is too early to confirm establishment. A leaf sucking bug, *Falconia intermedia*, and a pathogen, *Prospodium tuberculatum*, are currently undergoing host specificity testing and both agents are expected to be approved for release in Australia by December 1999.

For further information on lantana biological control see paper by M.D. Day and R.H. Holtkamp in these proceedings.

Scotch broom

Scotch broom, *Cytisus scoparius*, originated in Europe and has now spread to many temperate areas of the world. Its history is Australia is somewhat clouded although it is likely that original introductions of this species were as ornamentals. It is a serious problem in some parts of the tablelands regions of New South Wales, particularly the Barrington Tops, where it seriously affects native bushland, forestry and grazing land. Scotch broom is also a significant problem in Victoria, and Tasmania and to a lesser extent in the Adelaide Hills, South Australia.

A biological control campaign against Scotch broom commenced in 1990. The first release of a biological control agent was the twig mining moth, *Leucoptera spartifoliella* in 1993. It has since been released at a number of sites in New South Wales, Tasmania and Victoria and has established at some of these. The larvae of *L. spartifoliella* mine shoots of Scotch broom and heavy attack will stunt plant growth. The program continued with the release of the psyllid, *Arytainilla spartiophila*, in 1994. This insect feeds on buds and stunts the growth of young shoots. At present *A. spartifoliella* is only known to be established in the Southern Tablelands region of New South Wales. The third insect to be released was a seed feeding bruchid, *Bruchidius villosus*, in 1995. Larvae of this beetle feed on the developing seeds of Scotch broom. Two additional agents, the eriophyiid mite, *Aceria genistae*, and the seed feeding weevil, *Exapion fuscirostre*, are currently undergoing quarantine host specificity testing by NSW Agriculture and CSIRO in Canberra.

Blackberry

Blackberries, *Rubus fruticosus* complex, are a declared noxious weed throughout New South Wales. Blackberries of this complex originate in Europe and are now a major weed of pastures and forests on the Tablelands and adjoining regions of New South Wales as well as other areas of wet temperate southern Australia.

In New South Wales the *R. fruticosus* complex consists of at least seven taxa. *Rubus armeniacus* (previously *Rubus procerus* or *Rubus discolor*) is the most common blackberry in New South Wales. A survey carried out in 1984 estimated blackberry was causing an annual loss in New South Wales, Victoria and Tasmania of $42 million due to reduced production and control costs.

Biological control of blackberry began in the early 1980's with the study of the blackberry rust *Phragmidium violaceum*. This rust was studied in Europe, where it originated, to assess its safety as a control agent of blackberries in Australia. Research showed the rust is specific to blackberry and will not damage commercial varieties of raspberries or loganberries.

The blackberry rust project came to a halt in 1984 however when a strain of *P. violaceum* was discovered in Victoria. Apparently it had been introduced illegally. This strain was different to the strains of rust selected in Europe and therefore not very effective against the main forms of blackberry in Australia.

In 1986, Victoria applied to introduce the more damaging forms of the rust but the application was rejected after objections from people who considered blackberry useful. In October 1990, the Australian Quarantine and Inspection Service finally gave permission for Victoria to import and release the damaging rust strains which had been kept frozen in Europe since 1983. One of these strains was released in Australia in 1991.

P. violaceum is a defoliating pathogen which attacks blackberry leaves, flower buds, unripe fruit and green parts of growing canes. The rust appears as characteristic purple-brown blotches, 2-3 mm in diameter, on the top side of the leaf. Corresponding yellow or black powdery pustules of spores appear on the underside of the leaf.

There are five separate spore stages in the life cycle of the rust. The two most commonly seen stages are the golden, infectious, powdery, summer spores and the black, dormant, winter spores. The black or dormant rust spores germinate in spring and are spread by wind.

The rust can be spread manually by taking cuttings of infested plants and placing the cuttings into non infested bushes. This type of spread was carried out when the rust spores were in the yellow or infectious stage. The rust is now likely to have reached all suitable blackberry stands in New South Wales.

Blackberry rust can be confused with another rust, *Kuehneola uredinis*, commonly known as blackberry orange rust. This rust has been in Australia for at least 50 years. The infectious stage of both rusts is yellow but the dormant stages are different. The dormant stage of *K. uredinis* is grey while that of *P. violaceum* is black. Blackberry orange rust attacks older leaves in late summer and autumn. This rust does not cause as much damage as the more virulent strains of *P. violaceum*.

Blackberry rust can help to control blackberry but will not eradicate it. One strain of *P. violaceum* (F15) has been shown to kill *R. armeniacus* in high rainfall areas of Victoria and New South Wales. Unfortunately, in some of these areas *R. armeniacus* has been replaced by other taxa of blackberry. In addition, the rust may not work in drier parts of the state so conventional treatments should be continued.

Bridal creeper

Bridal creeper, *Asparagus asparagoides* (*Myrsiphyllum asparagoides*), is a native of South Africa which was originally introduced as an ornamental species. It has long since escaped the garden and is now considered to be a serious environmental weed in southern Australia. This species grows in all coastal, tableland and western slopes botanical divisions as well as the south western plains division of New South Wales.

Surveys in South Africa have indicated a range of potential biological control agents for *A. asparagoides*. This plant is actually uncommon in South Africa. There are currently three potential agents undergoing quarantine host specificity testing. Testing for the first of these, a leafhopper, *Zygina* sp. has finished and an application for its release was submitted in early 1999. Hopefully, by the time of this conference, approval will have been granted. A leaf feeding beetle, *Crioceris* sp., is currently being evaluated by CSIRO in Perth. Its release, if approved, is somewhat further away. The third agent is a pathogen, *Puccinia myrsiphylli*, which is being tested by CSIRO in Canberra. *P. myrsiphylli* causes considerable damage to bridal creeper in South Africa and if approved has the potential to be an important biological control agent in Australia.

Take Home Message

Biological control of environmental weeds, if successful, will reduce them to minor components of invaded vegetation. However, it must be remembered that biological control will not eradicate any weed species. Integrated control utilising a combination of biological control, strategic herbicide application, physical removal techniques and possibly fire may also be necessary. Any integrated program will have to ensure that sufficient biological control agents remain following other forms of treatment to ensure re-establishment of biological control agent populations. An ongoing commitment to control is vitally important as many of these species have long lived seed banks. It is

also essential that revegetation of disturbed habitat occurs quickly to prevent the niche previously occupied by a weed being reinvaded by the same species or by another (possibly worse) weed species.

ACKNOWLEDGMENTS

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PROSECUTIONS FOR NON COMPLIANCE UNDER THE NOXIOUS WEEDS ACT. 1993 (NEW SOUTH WALES)

Don Baldwin
Chief Weeds Officer
Upper Macquarie County Council, Bathurst

BACKGROUND:

My name is Don Baldwin and I am the Chief Weeds Officer of the Upper Macquarie County Council. I have worked as a weeds inspector for 26 Years.

I have been asked to present a paper about prosecutions under the Noxious Weeds Act, 1993. I will start with a brief background about the Upper Macquarie County Council.

Upper Macquarie County Council:

The Upper Macquarie County Council area covers the Council areas of Evans, Blayney and Oberon and the Cities of Bathurst and Greater Lithgow. It covers a total area of 15,220. km² and variable terrain with approximately 8,000 rural properties. It has 4,500 km of roads, which are sprayed annually for Noxious Weeds. The major weeds in the County area are

Serrated Tussock
St John's Wort
Nodding Thistle and
Blackberry

The Council has an inspectorial staff of 6 (including myself). During the last three years the Council has undertaken 5,400 inspections on private properties. We have also carried out 1,600 reinspections and 240 inspections of Crown Land and other Government Land.

Despite the number of inspections that Council staff have carried out Council has only launched prosecutions against 51 people. Of these 51 prosecutions, 27 have been withdrawn due to the work being carried out or some guarantee that the work would be done (eg a bond equivalent to the estimated cost of spraying to be carried out) and 18 have ended up in court. The 18 that ended up in court resulted in fines being incurred totaling $31,904.00. Some of the prosecutions launched have been on the same people for multiple weeds.

One of the most important things to remember is that the important issue is not the number of prosecutions launched but the number that can be avoided.

Prosecutions under the Noxious Weeds Act, 1993.

I will now turn to prosecutions under Section 19 of the Act, for failure to comply with a Weed Control Notice given under Section 18 of the Noxious Weeds Act, 1993.

What is a Weed Control Notice?

A Weed Control Notice is a notice issued under Section 18 of the Noxious Weeds Act, 1993 requiring an occupier of land to carry out work to control certain weeds in a certain manner by a certain time.

What is failure to comply with a Weed Control Notice

If a property owner does not carry out the requirement of the weed control authority and control the required weeds in an appropriate manner by the time allowed in the notice then the occupier has failed to comply with the notice.

Who is responsible for compliance with a Weed Control Notice?

Section 19 of the Act provides:

"An occupier of land (other than a Public Authority or a Local Control Authority) given a Weed Control Notice by a local Control Authority, or a successor in title to the occupier who has notice of the Notice, must not fail to comply with the Notice."

Maximum penalty: 100 penalty units.(A penalty unit equals $110.00, therefore the maximum penalty is $11,000.00.)

An example of a successor in title would be a purchaser of the property, who is given notice of the Weed Control Notice at the time of purchase, and who subsequently becomes the new registered owner of the property whilst the Weed Control Notice is still current.

Format of a Weed Control Notice:

Section 18 of the Act provides:

(1) A Local Control Authority may, by notice (a 'Weed Control Notice') given to an occupier of land (other than a public authority or a Local Control Authority), require the occupier to carry out any of the occupier's obligations to control noxious weeds on the land, as required under the specified control category or categories, in the manner specified in the Notice.

(2) The Notice may specify the time within which action is to be taken.

(3) The Local Control Authority may give a Weed Control Notice only if satisfied that an occupier has failed to carry out any of the occupier's obligations under this Act to control noxious weeds.

(4) A Local Control Authority or the Minister may by notice revoke or amend a Weed Control Notice given by the Authority."

Important points to consider when issuing a Weed Control Notice:

There are a number of pitfalls to a successful prosecution with respect to a Section 18 Weed Control Notice and care should be taken to ensure compliance with the following matters:

"1. A Weed Control Notice can only be given to an occupier of land. 'Occupier of land' is defined under the dictionary of words and expressions to the Act as meaning:

(a) the person for the time being entitled to possession of the land and includes, if the person so entitled does not reside on the land, the resident manager or other person in charge of the land; or ...."

Accordingly, a Weed Control Notice cannot be given to an owner, unless the owner is also the occupier. If the owner does not reside on the land, but employs a Manager, or enters into some contract for reward with a person who, for that reward, agrees to be in charge of the land, then those persons are deemed occupiers and may be liable for prosecution under the Section.

2. The Weed Control Notice may only be issued if the Local Control Authority is satisfied that an occupier has failed to carry out any of the occupier's obligations under the Act (subsection (3)). The obligations under the Act depend upon the "control category" for the relevant weed, which are set out at Section 9 of the Act. For example, for a W3 noxious weed, the Local Control Authority must be satisfied that the occupier has failed to prevent the weed from spreading and reduce its numbers and distribution before a Notice can be issued. The only way this can be determined is through a physical inspection of the property.

3. Assuming that there is a failure by the occupier to comply with the obligations of the Act, a Weed Control Notice may be issued. Subsection (2) of section 18 says that the Notice may specify the time within which action is to be taken. Accordingly, it is not mandatory that the Notice specified a timeframe within which action should be taken, however, it is strongly recommended that a time limit be given for certainty as to whether there has been compliance with the Notice or not.

4. In addition, the Notice must specify the manner in which the occupier is required to comply with their obligations under the Act (subsection (1)). Accordingly, every Notice should specify the means by which it is recommended the work be undertaken, ie by spraying, digging or mechanical means etc.

5. Finally, a Notice may be amended, but in essence the amended Notice would become a fresh Notice, for which non-compliance could lead to a prosecution.

Service of a Weed Control Notice:

Section 71 of the Act provides that a Notice is to be given in writing, either personally or by post. It also provides that a Notice may be given by affixing the Notice on a conspicuous part of the land or any building or other structure on the land, or by publishing the Notice in a newspaper circulating in the local area. If a Notice is given by post, it is to be treated as being properly addressed if it is addressed to the last known address of the occupier known to the Local Control Authority.

Procedure for prosecution under the Noxious Weeds Act, 1993:

To ensure compliance or non-compliance with the Weed Control Notice Council should re-inspect the property to determine the extent of the weed problem at the expiration of the notice. It is a good idea to take photographic or video evidence of the property to prove to the magistrate that there has been a failure to comply. Record the date of the re-inspection and if possible have the date imprinted on the photographs. Photographic evidence of the property prior to issuing the notice should also be available for the court case if necessary.

Failure to comply with a Weed Control Notice will entitle the Local Control Authority to issue a Summons for prosecution under Section 19 of the Act. The Summons is commenced by the laying of an information with the Local Court closest to the occupier - Section 61 of the Act.

The information and the summons need to have different wording for each weed category. That is the wording for a W1 weed states

To fully and continuously supress and destroy.

whilst the wording for a W3 weed would need to state

To prevent the said noxious weed from spreading and to reduce its numbers.

An example of a summons that Council uses is attached as Appendix A at the end of this presentation.

Time limit for commencing a prosecution:

The Noxious Weeds Act, 1993 does not specify the time limit within which a prosecution should be commenced. Accordingly, the provisions of the Justices Act, 1902 (New South Wales) apply requiring any Summons for prosecution **to be commenced within six months of the date of the offence**. The date of the offence is the date of expiry of the Notice, if there has been no compliance.

Service of a Summons:

The Justices Act provides that a Summons may be served personally, or by post. If the Summons is served by post, it must be served 28 days before the return date on the Summons.

Elements for a successful prosecution:

Section 75B of the Justices Act allows for the defendant to be prosecuted before the Magistrate, should there be no appearance by the defendant before the Court. If the defendant appears before the Court and wishes to defend the proceedings, then evidence will be required to be given to the Court as to all of the elements specified in Section 18 of the Act, and therefore it is essential that each

element of the Section be covered, and that appropriate evidence is available to be tendered before the Magistrate.
Accordingly, it is recommended that the following steps be taken when issuing a Notice under Section 18:

1. Find out who is the occupier of the land. Please note that the occupier may not necessarily be the owner. The occupier might be someone who is agisting on the property, someone who is leasing the property, someone who is a Manager of the property, or is in charge of the property.

2. Attend the property and satisfy yourself that, having regard to the relevant control category for the weed, the occupier has failed to carry out his obligations under the Act. At this point, it is a good idea to take a video or photographs of the extent of the infestation as physical evidence of the failure to comply with the statutory obligation. This is the best evidence which can be shown to Council to allow them to make a decision to prosecute or to be handed up to the Magistrate, as proof that it was reasonable to issue a Weed Control Notice to the occupier.

3. When issuing the Weed Control Notice, make sure that you specify not only the manner in which you recommend the eradication work to be undertaken, but also a time frame within which the work should be undertaken. These aspects are important as to the reasonableness of the Notice, or any subsequent argument as to whether the Notice has been complied with. That is, the Notice should give sufficient time to an occupier to undertake weed work, having regard to the nature of the weed and the season and the prevailing weather conditions. The period of the Notice should also be reasonable having regard to the recommended control method. For example, if by chemical spraying, the relevant chemical which is recommended to be used, the season in which the chemical is recommended to be used and the timeframe within which it becomes effective. Consideration should be given to the recommendations by the manufacturer of the chemical so that the occupier cannot produce the label to the chemical and show that its use as recommended by the manufacturer is inconsistent with the obligation as set out in the Notice.

4. After the Notice expires, again attend the premises for inspection to ascertain whether any weed work has been undertaken. Because of the residual effect of some chemical sprays, determine whether it is possible to say whether chemical has been sprayed or not. Perhaps, if it is recommended that a spray be used, include some requirement for a dye to be included in the spray to be used so that direct evidence that the spray was used will be able to be seen. Again, it is recommended that a video be taken, or photographs be taken on this occasion as direct evidence that there has been no compliance with the Notice, or insufficient compliance with the Notice.

5. Be aware that any prosecution for non-compliance of a Notice must be commenced within six months after the Notice expires. Be aware that with the residual effect of some chemical sprays, it may take up to six months to determine whether there has been compliance with the Notice. Do not allow the period for prosecution to elapse while waiting to determine whether sufficient work has been undertaken to comply with the Notice. As you are aware, depending upon climatic conditions, sufficient work may be undertaken but the chemical may not have the desired effect. Query whether in this circumstance, there has been compliance with the Act's requirements.

6. Make sure that the Notice has been served properly under the Act. Generally, the Notice should be posted to the last known address of the occupier on Council's records. However, if there is some

doubt as to whether the Notice will be received, consider personal service of the Notice, or take advantage of the other provisions in the Act such as fixing the Notice on a conspicuous part of the land or building, or publishing a Notice in the newspaper. Make sure that whatever form of service of the Notice you choose, that you can prove to the Court it was reasonable to use that method of service as the most effective method of making the occupier aware of the service of the Notice. Also be aware that there may be some benefit to the publishing of a notice in the local paper. This will cause embarrassment to the occupier.

7. Be aware that if the proceedings are defended, it will be your evidence, supported by photographs or video that will prove that you were entitled to issue the Notice and that there was not sufficient compliance with the Notice. Do not leave any area for doubt or disagreement with the occupier or a contractor engaged by the occupier to undertake the work.

8. When issuing the Summons, consider whether the Summons should be served personally to ensure service. If serving the Summons by post, make sure that it is served at the last known address of the defendant, at least 28 days before the return date before the Magistrate.

9. Finally, consider sending the occupier a letter asking the occupier to show cause why they should not be prosecuted for non-compliance with the Notice. This has a dual effect. Firstly, the occupier will have a second opportunity to comply with the Notice before prosecution. Alternatively, the occupier can explain to you which contractor they engaged and what work was done, which will help you understand whether there has been compliance, and your prospects of succeeding on a prosecution. Secondly, on any successful prosecution, it is helpful to prove to the Magistrate that every opportunity was extended to the occupier to undertake the required work before prosecution was commenced as a last resort

10. Finally, remember the primary goal is for the successful control of noxious weeds.

Take Home Message:

Council should only instigate prosecutions as a last resort. All means of achieving control of the noxious weeds should be attempted before the decision to prosecute is made.

Help the occupier to investigate the establishment of a weed control plan that is within their financial capabilities and Council requirements. Advise them on the proper use of appropriate chemicals and/or methods to control the particular weed.

A successful prosecution is not easy to achieve. It costs the occupier money and the weeds are still there to control. If it is for financial reasons that the occupier cannot comply with the notice then the imposition of a fine via a successful prosecution will only put the control of the weeds further behind.

If you must take an occupier to court for non-compliance then be sure that your case is supported by sufficient evidence to achieve a successful prosecution.

GIANT PARRAMATTA GRASS - PROSECUTION

Philip Martin
Senior Environmental Health Officer
Supervisor Noxious Weeds
Greater Taree City Council

INTRODUCTION

Greater Taree City Council is the Local Government body empowered with the control of noxious weeds throughout Councils area of approximately 3,753 sq kilometres.

Giant Parramatta Grass is the greatest noxious weed threat presently confronting Greater Taree City Council, the Department of Agriculture, landholders and others involved with agriculture.

Council is endeavouring to control this invasive noxious weed to the best of its ability based upon available funding and resources. Containment of this now well established weed is Council's main priority. Roadside control, inspections and follow up of private properties and public awareness continue to require increased attention and funding.

The control of spread from known infested properties is an important factor in overall control. Most landholders found to have infestations on their properties have been co-operative when requested to take action to control the weed. However, in a number of cases, some landholders or occupiers have ignored the directives issued and Council has had to take further measures, including the service of Section 18 Notices under the Noxious Weeds Act, 1993, with the threat of prosecution.

Council considers the institution of legal proceedings as a last resort and prefers that every opportunity be given by the Noxious Weeds Inspector to achieve the co-operation of the Landholder/Occupier to obtain a satisfactory result.

However, because of the seriousness and overall concern with this weed, Council resolved, at its meeting held in March 1998, that landholders who fail to control Giant Parramatta Grass on their property as requested by Council, will be subject to prosecution.

This was the case in relation to the occupier of a dairy farming property at Taree South who failed to comply with Council's Notice to control Giant Parramatta Grass on the property.

BACKGROUND

The property in question is heavily infested with Giant Parramatta Grass, the weed being positively identified through the Department of Agriculture. Despite constant inspections, requests, advice and previous notices, the occupier failed to adequately control the spread of this weed and the Giant Parramatta Grass has spread to cover the majority of the property.

The assistance of the property owner was also sought but to no avail. However, the occupier in this case, under his lease agreement, was responsible for the control of Noxious Weeds on the property.

As Giant Parramatta Grass is very difficult to control and there are a number of control methods, the occupier was requested to undertake control in accordance with the advice of a qualified Agronomist. An agronomic report was obtained by the occupier from the local District Agronomist with the Department of Agriculture. This document was subsequently referred to by Council when preparing the Notice.

An inspection by Council's Officers on 29 January 1998, revealed heavy infestations of Giant Parramatta Grass and reinfestation of previously sprayed buffer zones along the former Pacific Highway boundaries and the vehicular drive serving the property.

It was also noted that the property had large infestations of the Noxious Weeds Green Cestrum, Bathurst Burr and Noogoora Burr.

Two separate Notices under the Noxious Weeds Act, 1993 (Section 18), were then served on the occupier by hand delivery. The Notices were dated 4 February 1998 and allowed 28 days for compliance.

One Notice was served requiring control of Giant Parramatta Grass in the following manner:

"1. Provide a ten metre (10m) buffer zone along the North Eastern boundary of Lot 2, DP 776004 (fronting Pacific Highway) by spraying with an approved herbicide.

2. Provide a ten metre (10m) buffer zone along both sides of the vehicular access/driveway serving the dwellings and cattle yards located on the property."

(Refer to Attachment 1)

The other Notice required the control of the Green Cestrum, Bathurst Burr and Noogoora Burr *"by spraying with an approved herbicide or by way of hand removal or mechanical removal"*.

On Friday 20 March 1998, Council Officers reinspected the property to check on compliance with Council's Notices.

GIANT PARRAMATTA GRASS

It was evident that some boom spraying work had been undertaken along the front boundary and vehicular drive. However, the work was far from satisfactory and not in conformity with the terms of the Notice.

Photographs were taken of the extent of infestation and measurements recorded to show that compliance with the 10 metre buffer zone had not been achieved.

This distance is stipulated in Council's adopted guidelines "for a consistent approach by Noxious Weeds Authorities to landholders with Giant Parramatta Grass" (adopted by Council at its meeting held 23 May 1991). This guideline states that in endemic situations (such as the occupier's property) the first priority must always be containment.

The occupier had failed to comply with the terms of Council's Notice in that the 10 metre zone had not been established. Furthermore the work undertaken was unsatisfactory in that areas of the weed were missed, particularly along the edge of the driveway, an area of major concern regarding spread of seed by vehicles. The distance sprayed by the occupier was less than 3 metres.

GREEN CESTRUM, BATHURST BURR AND NOOGOORA BURR

On inspection it was evident that the majority of these weeds had not been controlled as required by the Notice. The Burr weeds had progressed to seeding and covered large areas of the property. There was evidence of some spraying work but only to a small area of the infestation. When interviewed, the occupier stated that he had sprayed the remainder of the weeds "earlier in the week, Tuesday or Wednesday". If this was the case the terms of Council's Notice requiring control within 28 days had not been complied with and the delay had allowed seeding to take place.

Subsequently a Penalty Infringement Notice was issued upon the occupier ($200 penalty) for failing to comply with the terms of Council's Notice to control the Green Cestrum, Bathurst Burr and Noogoora Burr.

The penalty was paid by the occupier.

FAILURE TO COMPLY WITH GIANT PARRAMATTA GRASS NOTICE

The matter relating to the non compliance with Council's Notice to Control the Giant Parramatta Grass was subsequently referred to Council for determination. The Council was advised that the infestation existing on the property had been of concern to Council Officers, landholders and Government Departments involved in agriculture for a considerable period, and despite Council's previous notices, advice and persistence to seek the owner and occupier's co-operation, the control of this invasive Noxious Weed had been far from satisfactory.

Council's Notice dated 4 February required only minimal work to be undertaken in an attempt to assist in containing the problem yet the occupier had failed to comply.

Council resolved to take the next step and prosecute the occupier for failure to comply with the terms of the Notice. It was further resolved that upon determination of the matter, Council consider entering upon the property and undertaking the work as required in accordance with Section 20 of the Noxious Weeds Act, 1993.

THE PROSECUTION

Legal matters on behalf of Council are dealt with by one of two local legal firms. In this case, the matter was dealt with by Davies Spicer Drake, Solicitors, Taree.

The matter was adjourned on two separate occasions at Taree Local Court with the Defendant's Solicitor seeking further particulars in relation to the matter, including, in point form, details by way of date and detail of each of the inspections, requests, advice and previous Notices provided to the Defendant.

The prosecution proceeded on 23 June 1998, at Taree Local Court.

The Defendant pleaded guilty to the matters set out in the Summons. A statement of facts was handed up, together with a series of colour photocopies taken off the photographs in Council's file.

(Refer to Attachments 2 and 3 for copies of the Information and Summons)

The Defendant's Solicitor made submissions on behalf of the Defendant. These included:

1. The Defendant had received no assistance whatsoever from the owner of the land despite a number of requests of the owner.
2. The Defendant was struggling financially.

After hearing all the matters, His worship convicted the Defendant with respect to the matter, imposed a fine of $300 and ordered him to pay Court costs of $336 within 28 days.

The maximum penalty under Section 19 of the Noxious Weeds Act for occupiers of land who fail to comply with a Weed Control Notice is 100 penalty units ($11,000).

CONCLUSION

At the time, Council was advised that this prosecution was believed to be the first prosecution for failure to control Giant Parramatta Grass.

Although the penalty in this case was minimal compared to the maximum penalty provided, it has resulted in improved co-operation between the occupier and Council. Council's Noxious Weeds Inspector is undertaking control trials on the property and recent control measures undertaken by the occupier have been instigated without undue Council pressure.

TAKE HOME MESSAGES

1. Keep accurate records of all inspections, dates, observations, interviews and correspondence.
2. Take photographs.
3. Ensure all records, photographs, etc, are stored on a central filing system.
4. The control requirements stipulated in formal Notices under the Noxious Weeds Act should be accurately defined and achievable within a reasonable period of time.
5. Advise Council of any legal action proposed and seek Council's endorsement, if necessary.
6. Consider the issue of a Penalty Infringement Notice rather than Court Proceedings, taking into consideration the time and costs involved in proceeding through the Courts. However, if issuing Penalty Infringement Notices, ensure accurate records are maintained in case the matter does proceed to Court.

ATTACHMENT 1

Greater Taree CITY COUNCIL

NOXIOUS WEEDS
Noxious Weeds Act 1993, Section 18

NOTICE

4 February 1998

Mr XXXXX
Pacific Highway
TAREE NSW 2430

Dear Sir

Description and situation of land to which notice relates:
Lot 2, DP776004, Pacific Highway, Taree South, Parish of Tinonee

Notice is hereby given in accordance with Section 18 of the Noxious Weeds Act 1993, as amended by subsequent Acts, that the undermentioned plant which has, in accordance with the provisions of such Act, been declared to be a noxious weed has been found to be growing upon the land (above described). As the Council is satisfied that you are not taking reasonable and effective measures to control such plants on your land as required under the Act, you are hereby required to control such plants in the following manner:-

1. Provide a ten metre (10m) buffer zone along the north eastern boundary of Lot 2, DP776004 (Fronting Pacific Highway) by spraying with an approved herbicide.

2. Provide a ten metre (10m) buffer zone along both sides of the vehicular access/ driveway servicing the dwellings and cattle yards located on the property.

NOTE: Control should be undertaken in accordance with the recommendations of the Department of Agriculture and Council and follow up pasture improvement will be necessary to control this weed.

Common Name: Giant Parramatta Grass *(Sporobulus indicus var.major)* Category W2

ATTACHMENT 1 (CONT)

NOXIOUS WEEDS ACT CATEGORY W2

A weed which poses a threat to agriculture, the environment, or the community and has the potential to spread to other areas. The noxious weed should be fully and continuously suppressed and destroyed.

WORK TO BE COMPLETED WITHIN 28 DAYS FROM THE DATE OF THIS NOTICE

The Act provides that if any owner or occupier fails to comply in any particular way with the requirements of a notice given to him under Section 18 of the Act he shall be liable to a penalty not exceeding $10,000.

As occupier of the land, you may appeal against this Notice to the Land and Environment Court within 28 days for its amendment or revocation (Section 25)

Should you fail to comply with this Notice the Council may enter upon the land and control the noxious weed as required. The Act provides that any costs and expenses incurred by the Council is payable by the occupier of the land on demand to the Council.

Yours faithfully

W H DEER
DIRECTOR
COMMUNITY DEVELOPMENT & HEALTH

ATTACHMENT 2

FOR HEARING AT THE TAREE LOCAL COURT
ON 26 MAY 1998

INFORMATION - GENERAL PURPOSES

Noxious Weeds Act, 1993, section 19
Justices Act, 1902, section 75B

BE IT REMEMBERED THAT on this 8th day of May in the year of Our Lord one thousand nine hundred and ninety eight at Taree in the State of New South Wales, PHILIP RICHARD MARTIN, Senior Environmental Health Officer, Greater Taree City Council (hereinafter called "the Informant") of Pulteney Street, Taree appears before me, the undersigned, one of Her Majesty's Justices duly assigned to keep the Peace of Our Sovereign Lady the Queen in and for the said State, and informs me that between 4 February 1998 and 5 March 1998 at Taree in the said State, one <NAME> (hereinafter called "the Defendant") did fail to comply with a Weed Control Notice.

FURTHER PARTICULARS:

By notice dated 4 February 1998 served upon the Defendant being an occupier of land the Greater Taree City Council required the Defendant to carry out the occupier's obligations to control noxious weeds on the laud uamely Lot 2 DP 862928 at Pacific Highway, Taree South, Parish of Tinonee and County of Macquarie with respect to the category W2 weed Giant Parramatta Grass and the Defendant failed to do so.

Contrary to the Act or regulation in such case made and provided; whereupon the said Informant prays that I the said Justice will proceed in the premises according to law.

.....

EXHIBITED AT TAREE
in the said State on the
day first above written,
before me

Justice of the Peace

ATTACHMENT 3

SUMMONS

DIVISIONS 1 and 2, "JUSTICES ACT, 1902",

Noxious Weeds Act, 1993, section 19

TO <NAME>
Of Pacific Highway, Taree South
in the State of New South Wales.

WHEREAS on the 8th day of May in the year of Our Lord one thousand nine hundred and ninety eight at Taree in the State of New South Wales, PHILIP RICHARD MARTIN, Senior Environmental Health Officer, Greater Taree City Council (hereinafter called "the Informant") of Pulteney Street, Taree appeared before me, the undersigned, one of Her Majesty's Justices duly assigned to keep the Peace of Our Sovereign Lady the Queen in and for the said State, and informs me that between 4 February and 5 March 1998 at Taree in the said State, one <NAME> (hereinafter called "the Defendant") did fail to comply with a Weed Control Notice.

FURTHER PARTICULARS:
By notice dated 4 February 1998 served upon the Defendant being an occupier of land the Greater Taree City Council required the Defendant to carry out the occupier's obligations to control noxious weeds on the land namely Lot 2 DP 862928 at Pacific Highway, Taree South, Parish of Tinonee and County of Macquarie with respect to the category W2 weed Giant Parramatta Grass and the Defendant failed to do so.

These are therefore to command you the said Defendant, in Her Majesty's name, to be and appear on Tuesday 26 May 1998 at ten of the clock in the forenoon at the LOCAL COURT, TAREE in the said State, before such Stipendiary Magistrate or Justice or Justice of the Peace for the said State as may then be there to answer to the said information, and to be further dealt with according to law.

GIVEN under my Hand and Seal this 8th day of May
in the year of Our Lord one thousand nine hundred
and ninety eight at Taree in the said State.

Justice of the Peace

CURRENT AND RECENT WEED BIOLOGICAL CONTROL PROJECTS RELEVANT TO NEW SOUTH WALES

Paul R. Sullivan
Senior Technical Officer
Weed Biological Control Unit &
CRC for Weed Management Systems
RMB 944 Calala Lane
Tamworth NSW 2340

INTRODUCTION

Biological control programs have been targeting weeds since the mid 19th century when the cochineal insect *Dactylopius ceylonicus* was deliberately used in Sri Lanka to control smooth tree pear *Opuntia vulgaris*. Since then many weeds have been the target of biological control programs which have met with varying success.

Over the last 30 years there has been an acceleration in the number of weed biological control programs in Australia. This paper lists information on current and recent weed biological control projects relevant to New South Wales. Lists are alphabetical with plant species being listed under family classification.

ALISMATACEAE

Alisma, *Alisma lanceolatus*

Alisma is a native of Europe, Africa and Asia. It is found on the south western plains of NSW and is a problem in the Riverina irrigation areas.

Pathogens occurring in Australia (in particular the fungus, *Rhynchosporium alismatis*) are being evaluated as potential mycoherbicides. Biology and host specificity of *R. alismatis* is being studied with field trials possibly being undertaken in 1999.

Starfruit, *Damasonium minus*

Starfruit is an Australian native and is found on the north and central coasts, the northern tablelands, central and south western slopes and north western plains of NSW. This species is a problem in the Riverina irrigation areas.

Pathogens occurring in Australia (in particular the fungus, *Rhynchosporium alismatis*) are being evaluated as potential mycoherbicides. Biology and host specificity of *R. alismatis* are being studied.

ASPARAGACEAE

Bridal creeper, *Asparagus asparagoides*

Bridal creeper is native to South Africa and is found on Lord Howe Island and in all coastal, tableland and western slopes regions as well as the south western plains of NSW. For information on biological control of bridal creeper see paper by Holtkamp in these proceedings.

ASTERACEAE

Ragweeds, *Ambrosia* spp.

The 4 *Ambrosia* species found in NSW are native to the Americas. They thrive on a variety of soil types and in various habitats and occur in most regions of the state. Two of these, *A. tenuifolia* and *A. psilostachya,* are declared noxious weeds in some Local Control Authority (LCA) areas of NSW (see Appendices 1 and 2).

Larvae of *Epiblema strenuana*, a moth introduced for control of parthenium weed, also damage ragweed but control is inadequate. Larvae form galls in stems and axillary buds. Heavy attack leads to stunted plants with reduced competitiveness and seed production.

On the NSW north coast the leaf beetle *Zygogramma bicolorata* has established on annual ragweed, *A. artemisiifolia*. Larvae and adults defoliate plants and though locally damaging the overall impact is negligible.

Nodding thistle, *Carduus nutans*

Nodding thistle is native to Europe, north Africa and Asia. It occurs mainly in annual pastures on the tablelands of NSW. It is a declared noxious weed in some LCA areas of NSW (see Appendices 1 and 2).

Larvae of the receptacle weevil, *Rhinocyllus conicus*, feed in the receptacle and developing seeds. It is established in nodding thistle in NSW and destroys up to 35% of seeds.

Larvae of the seed fly, *Urophora solstitialis*, feed in developing seeds and incorporate surrounding seeds into a woody gall. Where the fly has been released there has been a reduction of up to 70% of seedlings one year later. The seed fly breeds rapidly and is being actively redistributed.

Larvae of the rosette weevil, *Trichosirocalus horridus*, feed in the crown of over wintering rosettes. This is the most damaging and promising agent killing up to 40% of rosettes and reducing seeding of survivors by 70%. This agent has one generation a year and is being actively redistributed.

Slender thistles, *Carduus* spp.

Two slender thistles, *C. pycnocephalus* and *C. tenuiflorus*, can be found in most regions of NSW. They are native to Europe. Slender thistles are weeds of pastures and neglected areas receiving more than 500mm rainfall per annum.

The rust *Puccinia cardui-pycnocephali* has been released in NSW along with two more virulent strains from Europe. These attack all above ground parts of the plant. Unfortunately drought conditions hampered the release program and there is limited evidence of rust survival over summer.

Saffron thistle, *Carthamus lanatus*
Saffron thistle is native to the Mediterranean region and western Asia. It is found in all regions of the state. Saffron thistle is widespread in cultivated paddocks and pastures in areas receiving between 300 and 600mm rainfall per annum. It is a declared noxious weed in one LCA area of NSW (see Appendices 1 and 2).

Finding host specific biological control agents of saffron thistle has proved difficult because it is closely related to safflower, *Carthamus tinctorius*. A fly, *Botanophila turcica*, and two pathogens, *Puccinia sommeriana* and *Septoria centrophylli*, have been identified as good candidates for further study.

Sifton bush and related species, *Cassinia* spp.
Cassinia spp. are Australian natives. They are widespread on disturbed and overgrazed areas of the tablelands and western slopes. *Cassinia arcuata* is a declared noxious weed in some LCA areas of NSW (see Appendices 1 and 2).

Two native scale insects, *Austrotachardia* sp. and *Paratachardina* sp., cause considerable damage to *Cassinia* sp. and have been distributed on approximately 300 properties with some excellent results. Studies are currently being conducted on the life cycle and dispersal of these insects with a view to using them for control of these woody weeds.

Skeleton weed, *Chondrilla juncea*
Skeleton weed is native to Europe and western Asia and occurs throughout NSW. It is a weed of winter cereal crops. Three forms of the weed occur in Australia; narrow leaf, intermediate and broad leaf forms.

The rust *Puccinia chondrillina* attacks all aerial parts of the plant. One strain of the rust has successfully controlled the narrow leaf form and another strain of the rust that is virulent on the intermediate leaf form of skeleton weed (Strain TU788) was extensively released in 1997.

Bitou bush, *Chrysanthemoides monilifera* ssp. *rotundata*, and boneseed, *Chrysanthemoides monilifera ssp. monilifera*
Chrysanthemoides monilifera is native to South Africa where there are six subspecies. Two of the six subspecies have been introduced to Australia. In NSW they are a problem in coastal areas. *C. monilifera* is a declared noxious weed in some LCA areas of NSW (see Appendices 1 and 2). For information on *Chrysanthemoides* spp. see paper by Holtkamp in these proceedings.

Spear thistle, *Cirsium vulgare*
Spear thistle is native to Europe, western Asia and north Africa. It is found in all regions of NSW and occurs in a wide range of environments, particularly in overgrazed pastures on the tablelands. Spear thistle is also considered to be a major weed of rice rotations in the Riverina irrigation areas.

Larvae of the receptacle weevil, *Rhinocyllus conicus* (spear thistle strain), feed in the receptacle and developing seeds.

Larvae of the seed fly, *Urophora stylata*, feed in developing seeds and incorporate surrounding seeds into a woody gall. The seed fly breeds rapidly and is established in NSW. In Canada a 65% reduction in seed formation was achieved in some areas 3 years after the fly was released.

Larvae of the rosette weevil, *Trichosirocalus horridus*, feed in the crown of over wintering rosettes. This is the most damaging and promising agent but has been hard to establish. This agent has one generation a year and has been released in NSW. It has established near Adaminaby.

Crown rot, *Phoma* sp., occurs in Australia and is being evaluated as a potential bioherbicide. This pathogens interaction with *T. horridus* larvae is also being evaluated.

Onopordum thistles, *Onopordum* spp., Scotch, Illyrian and Stemless

Scotch thistle, *Onopordum acanthium,* is native to Europe, western and central Asia and Asia Minor. It is a weed of pastures and lucerne crops on the fertile soils mainly of the central and southern tablelands and slopes. Scotch thistle can also be found on the central coast, northern tablelands and plains areas of NSW.

Illyrian thistle, *Onopordum illyricum,* is native to the Mediterranean region and Asia Minor. It is a pasture weed of the central and southern tablelands and slopes where it seems to have hybridised with Scotch thistle forming a 'complex' of Scotch and Illyrian thistles and their intermediates.

Stemless thistle, *Onopordum aculon,* is native to the western Mediterranean region. It occurs on the northern tablelands and slopes and plains regions of NSW and is at its densest in pastures in the south west of the state.

Onopordum thistles are declared noxious weeds in some LCA areas of NSW (see Appendices 1 and 2).

Larvae of the weevil, *Larinus latus*, feed on developing seeds. This weevil has established in NSW. Larvae of the weevil, *Lixus cardui*, mine stems. It is well established in NSW. These two weevils will continue to be released in NSW in the near future.

Larvae of the weevil, *Trichosirocalus* sp. nov., mine rosette crowns and meristems. Larvae of the moth, *Eublemma respersa*, mine the leaf petioles and root crowns. The weevil *T.* sp. nov. and the moth, *E. respersa*, were released in spring 1998 and it is too early to know whether establishment has occurred.

Release of the fly, *Botanophila spinosa*, (whose larvae mine the rosette crown and meristem) will be made in spring 1999.

The fly, *Urophora terebrans*, whose larvae form galls in the flower head, is in quarantine undergoing host specificity testing.

Larvae of the fly, *Tephritis postica*, feed on developing seeds. *T. postica* did not establish in the field and has been dropped from the program. Also the sap sucking plant hopper, *Tettigometra sulfurea*, will not be released because there were concerns that ants (attracted by this agent) would have a detrimental effect on other agents.

Variegated thistle, *Silybum marianum*

Variegated thistle is native to the Mediterranean region, the Soviet Union and Asia Minor. It is found in all regions of NSW and is particularly troublesome in pastures and cereal crops on the tablelands and slopes.

Larvae of the receptacle weevil, *Rhinocyllus conicus*, (variegated thistle strain) feed in the receptacle and developing seeds.

Noogoora burr, *Xanthium occidentale*
Noogoora burr is native to North America and is widespread through northern and western NSW. It is a weed of grazing, cultivation and undeveloped areas subject to summer rain and floods. Noogoora burr is a declared noxious weed in some LCA areas of NSW (see Appendices 1 and 2).

Larvae of the moth, *Epiblema strenuana,* form galls in stems and axillary buds. It is established in NSW but does not appear to control noogoora burr.

The rust, *Puccinia xanthii*, attacks all aerial parts of the plant. It is present and widespread in NSW but is limited by dry conditions.

Bathurst burr, *Xanthium spinosum*
Bathurst burr is native to South America and is found in all regions of the state. It is a weed on high fertility disturbed soils. Bathurst burr is a declared noxious weed in some LCA areas of NSW (see Appendices 1 and 2).

A naturally occurring pathogen, *Colletotrichum orbiculare*, attacks all aerial parts of the plant. It is being developed as a mycoherbicide.

An exotic pathogen, *Cerospora xanthicola*, will be tested in quarantine. This pathogen also attacks all aerial parts of the plant.

BORAGINACEAE
Paterson's curse, *Echium plantagineum*, and related *Echium* species
Paterson's curse is native to the Mediterranean region and western Europe. It is found in all regions of NSW and is abundant on the central and south western slopes and eastern Riverina regions. It often becomes the dominant plant in winter pastures.

Vipers bugloss, *Echium vulgare*, is native to Europe and Asia Minor. It occurs in many areas of NSW and is abundant on the central and southern tablelands.

Italian bugloss, *Echium italicum*, is native to the Mediterranean and western Asia. Isolated patches occur in the central and south western slopes and south western plains.

Echium spp. are declared noxious weeds in some LCA areas of NSW (see Appendices 1 and 2). Biological control agents are expected to affect all *Echium* weeds.

Leaf-mining moths, *Dialectica scalariella,* are widespread and common on Paterson's curse and viper's bugloss. Damage to Paterson's curse occurs when moth larvae form mines within the leaves (mainly on the lower side). These mines become blisters as larvae grow. Isolated areas of significant

damage have occurred. Moth numbers are reduced by low winter temperatures, parasitic wasps and scarcity of *Echium* weeds during summer.

Crown weevils, *Mogulones larvatus*, have been released at over 500 sites and are well established. Young larvae initially feed inside leaf stalks moving down into the root crown. Up to 90% of both Paterson's curse and viper's bugloss rosettes have been killed at well established ungrazed sites where the weevil is well established. Populations have been slow to build up at grazed sites. Harvesting and redistribution of crown weevils from field sites is continuing.

Root weevils, *Mogulones geographicus*, have been released at 8 sites and have established. Larvae of this weevil feed mostly in the tap root but also in the root crown. The root weevil will continue to be mass reared and released.

Two flea beetle species have also been released. Adults of one of these, *Longitarsus aeneus*, were released directly into the field by CSIRO but did not establish. *L. aeneus* has been dropped from the program as it was not possible to breed under laboratory conditions. Adults of another flea beetle, *Longitarsus echii*, feed on rosette leaves while larvae feed inside the tap root. *L. echii* will continue to be mass reared and released.

Stem beetles, *Phytoecia coerulescens*, have also been released. Larvae feed inside larger stems and move to lower plant parts where they remain until the following spring. These beetles are cannibalistic with usually only one survivor emerging from each plant.

Flower-feeding beetles, *Meligethes planiusculus*, were the last of the insects to be released into the field. Larvae feed on flower buds, flowers and developing seeds. After flowering finishes, adult flower beetles remain fairly inactive through the remainder of summer, autumn and spring. Flower-feeding beetles will continue to be mass reared and released.

Most agents breed slowly so it will take many years for them to breed up and disperse naturally throughout NSW. When numbers build up the crown weevil, root weevil and flea beetle are expected to be the most damaging agents for Paterson's curse.

Blue heliotrope, *Heliotropium amplexicaule*

Blue heliotrope is native to South America. It is widespread on pastures and fallows in northern inland NSW and can be found in most regions. Blue heliotrope is a declared noxious weed in some LCA areas of NSW (see Appendices 1 and 2).

Potential agents in Argentina will be examined and tested over the next two years. These include a leaf feeding chrysomelid beetle, *Deuterocampta quadrijuga*, a root feeding flea beetle, *Longitarsus* sp., a tingid bug that sucks sap from plant cells (*Dictyla* spp.) and a galling thrip, *Haplothrips heliotropii*.

Common heliotrope, *Heliotropium europaeum*

Common heliotrope is native to central Europe, western Asia and northern Africa. It is widespread in NSW and is abundant in pastures of the central and south western slopes and plains.

The rust, *Uromyces heliotropii*, is being redistributed in NSW. It has established but at present is not very damaging.

CACTACEAE

Harrisia cactus, *Harrisia martinii*

Harrisia is native to South America. In NSW it occurs adjacent to the Qld border on the north western plains and as isolated patches in other regions. It is a declared noxious weed in NSW (see Appendices 1 and 2).

The sap sucking mealybug, *Hypogeococcus festerianus*, has provided excellent control in Qld and is being used in NSW.

Prickly Pears, *Opuntia* spp.

Opuntia spp. are native to the Americas and occur in all regions of NSW. All *Opuntia* spp. except *Opuntia ficus indica* are declared noxious weeds in NSW (see Appendices 1 and 2).

Most of these weeds can be controlled by using one of the four species of cochineal insects, *Dactylopius* spp., often in conjunction with the moth *Cactobalastis cactorum*.

CLUSIACEAE

Tutsan, *Hypericum androsaemum*

Tutsan is native to Europe, Asia Minor and northern Africa. In NSW it occurs but is not troublesome in most areas except the Blue Mountains where it is locally abundant.

The fungus, *Melampsora hypericorum*, defoliates plants leading to plant death after several years. This effective agent has been recently released in the Blue Mountains.

St John's wort, *Hypericum perforatum*

St John's wort is native to Europe, western Asia and northern Africa. It is a pasture and bushland weed of the tablelands and slopes regions of NSW. St John's wort is a declared noxious weed in some LCA areas of NSW (see Appendices 1 and 2).

The defoliating beetle, *Chrysolina quadrigemina*, is often quite damaging but is ineffective in semi timbered country.

The aphid, *Aphis chloris*, has been widely distributed but its impact has been variable and generally this species has little impact.

The mite, *Aculus hyperici*, stunts growth, weakens and slowly kills plants. Distribution of this agent is continuing.

The beetle, *Agrilus hyperici*, has been recently reimported and released in NSW. Larvae of this beetle feed inside roots.

Release of a form of the damaging fungus, *Colletotrichum gloeosporioides*, have been put on hold due to doubts over its host specificity.

FABACEAE

Scotch broom, *Cytisus scoparius*

Scotch broom is native to Europe. In NSW it is a weed on the tablelands and south western slopes in bushland, roadsides and neglected areas of moderate to high rainfall. It is a declared noxious weed in some LCA areas of NSW (see Appendices 1 and 2). For information on biological control of Scotch broom see paper by Holtkamp in these proceedings.

Gorse, *Ulex europaeus*
Gorse is native to Europe and is considered in some countries such as New Zealand to be their most serious pasture weed. It is a weed of grazing and forested areas and occurs on the north and central coasts, central tablelands and central and south western slopes of NSW. Gorse is a declared noxious weed in some LCA areas of NSW (see Appendices 1 and 2).

The mite, *Tetranychus lintearius*, was released in Victoria and Tasmania in 1998. This mite has been damaging in the USA and New Zealand.

LAMIACEAE
Horehound, *Marrubiun vulgare*
Horehound is native to Europe, Asia and northern Africa. It is found in all regions of NSW and is a common weed of disturbed areas and pastures in the inland. Horehound is a declared noxious weed in some LCA areas of NSW (see Appendices 1 and 2).

The plume moth, *Wheeleria spilodactylus*, previously known as *Pterophorus spilodactylus*, was released in 1994. It has established at most release sites. Larvae have caused massive defoliation killing up to 25% of plants at some sites. The plume moth does not like hot areas and works best in areas receiving > 600 mm rainfall per annum.

Larvae of the clear wing moth, *Chamaesphecia mysiniformis*, feed inside the roots. It has been released in SA and Victoria and is due to be released in NSW in early 2000. In Europe this moth kills up to 50% of plants. Younger plants 1 and 2 years old are most susceptible to the clear wing moth.

Host specificity testing of the flower beetle, *Meligethes* sp., will be conducted at KTRI Victoria.

POACEAE
Wild oats, *Avena* spp.
Avena species are native to Europe, Asia and north Africa and occur in all NSW regions. They are weeds in cereal crops.

Screening of a wide range of Australia pathogens for virulence and selectivity in wheat has indicated that the rust, *Drechslera avenaceae*, is the most promising. Infection requirements are being assessed.

Serrated Tussock, *Nassella trichotoma*
Serrated tussock is native to South America and is considered the worst weed in NSW. It is most troublesome on the southern and central tablelands but there are many other infestations on the

northern tablelands and elsewhere. Serrated tussock is a declared noxious weed in some LCA areas of NSW (see Appendices 1 and 2).

Potential agents in Argentina will be examined and tested over the next two years. These include a collar rot fungus, *Corticum* sp., and a rust, Puccinnia sp. Other fungal pathogens have been found to attack serrated tussock in its native range and may also be examined.

POLYGONACEAE
Docks, *Rumex* spp.

Swamp dock, *Rumex brownii*, is an Australian native while curled dock, *Rumex crispus*, broadleaf dock, *Rumex obtusifolius*, clustered dock, *Rumex conglomeratus*, and fiddle dock, *Rumex pulcher*, are exotics from Asia, Europe and the Mediterranean region. Docks like moist soils and are found in all regions of the state. They are weeds of pastures, arable land, roadsides and disturbed areas.

Larvae of the clear wing moth, *Chamaesphecia doryliformis*, feed in large roots of dock plants. This agent has established at many of its release sites with varying levels of success. This program will finish in 1999.

Emex/Doublegee, *Emex australis*, *Emex spinosa*
E. australis is native to southern Africa and is a declared noxious weed in some LCA areas of NSW (see Appendices 1 and 2). *E. spinosa* is rare in NSW and has not been declared noxious in NSW. *E. spinosa* is native to the Mediterranean region and Asia Minor. There is evidence of hybridisation between these two *Emex* species. *Emex* are weeds of grazing and cropping lands, saleyards, vineyards and neglected areas and can be found in most regions of the state.

Larvae of the weevil, *Apion miniatum*, mine the base of stems. This weevil was released in NSW in 1999.

PONTEDERIACEAE

Water hyacinth, *Eichhornia crassipes*

Water hyacinth is native to the Amazon River Basin of South America and is a declared noxious weed in NSW (see Appendices 1 and 2). It is most troublesome in still and slow moving freshwater bodies with elevated nutrient levels on the north and central coasts and north western plains of NSW.

The weevils, *Neochetina eichhorniae* and *Neochetina bruchi*, and the moth, *Niphograpta albigutallis* (also known as *Sameodes albigutallis*), were released in NSW in 1975, 1990 and 1977 respectively. Larvae of these three agents bore in leaf bases and plant crowns. They have had varying and sporadic success. Moth larvae work best on young and regrowth plants.

The moth, *Xubida infusella* (previously known as *Acigona infusella*), was released in 1998. Larvae feed in petioles and plant crowns. Rearing and release of this moth are continuing.

ROSACEAE

Blackberry, *Rubus* spp.

Most noxious blackberries in NSW are native to Europe. They are declared noxious weeds in some LCA areas of NSW (see Appendices 1 and 2). Blackberries are most troublesome in the eastern half of the state in areas receiving > 750 mm rainfall per annum and can be found in a wide range of habitats. For information on biological control of blackberry see paper by Holtkamp in these proceedings.

VERBENACEAE

Lantana, *Lantana camara*

L. camara is of garden origin with parents native to tropical Central America. It occurs on roadsides, creek banks, fence lines, pastures, parkland and arable fields, and may become the dominant understorey in open forests and tropical tree plantations. In NSW lantana occurs in coastal regions, and on Lord Howe and Norfolk Islands. Lantana is a declared noxious weed in some LCA areas of NSW (see Appendices 1 and 2). For information on biological control of lantana see paper by Holtkamp in these proceedings.

TAKE HOME MESSAGES

Weeds will continue to be the target of biological control programs because biological control has environmental and economic advantages over alternative methods. Education of those involved with biological control programs, however, is essential for their efficient application. Safety of biological control programs, where they can and cannot be used effectively and the time involved for control to be achieved are all issues that need to be understood.

The effectiveness of biological control programs depends on the agent, the weed genotype and the environment. Biological control is often slow compared to chemical control and it may take many years before weed control is achieved. For these reasons it is often necessary that integrated weed control methods be employed in conjunction with biological control programs. The public are sometimes told that "it may be their children that reap the benefits of a biological control program and that other conventional methods of weed control may need to be employed in the interim."

Many of the biological control programs in this paper are cooperative ventures between NSW Agriculture and other agencies. Collaborators include

- CRC for Weed Management Systems
- Local Weed Authorities
- CSIRO
- Dept of Conservation and Natural Resources, Victoria
- South Australian Research and Development Institute
- Agriculture Western Australia
- Dept of Natural Resources, Qld
- National Parks and Wildlife Service of NSW
- Landcare
- Herbarium staff
- Public

ACKNOWLEDGMENTS

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I would like to thank Mr A.J. Maguire for help preparing the appendices and Dr J.R. Hosking and Mr R.H. Holtkamp for providing useful comments on early versions of the manuscript.

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Appendix 1 Declared Noxious Weeds in NSW with current and recent biological control programs. The table shows declaration categories for these weeds (see Appendix 2) and number of Local Control Authorities (LCA) having each category. List is alphabetical according to common name.

Common name	Botanical name	Category	LCA
Bathurst/Noogoora/Californian/Cockle	*Xanthium* spp.	W2	53
Bathurst/Noogoora/Californian/Cockle	*Xanthium* spp.	W2/W3	2
Bathurst/Noogoora/Californian/Cockle	*Xanthium* spp.	W3	41
Bitou bush/Boneseed	*Chrysanthemoides* spp.	W1	1
Bitou bush/Boneseed	*Chrysanthemoides* spp.	W2	11
Bitou bush/Boneseed	*Chrysanthemoides* spp.	W3	44
Blackberry	*Rubus fruticosus* (agg.)	W2	88
Blackberry	*Rubus fruticosus* (agg.)	W3	31
Blue heliotrope	*Heliotropium*	W2	8
Blue heliotrope	*Heliotropium*	W3	3
Gorse	*Ulex europaeus*	W2	23
Harrisia cactus	*Harrisia* spp.	W4f	137
Horehound	*Marrubium vulgare*	W2	12
Horehound	*Marrubium vulgare*	W3	19
Lacy ragweed	*Ambrosia tenuifolia*	W2	1
Lantana	*Lantana camara*	W2	1
Lantana (Pink flowered)	*Lantana camara*	W2	38
Lantana (Pink flowered)	*Lantana camara*	W3	1
Lantana (Red flowered)	*Lantana camara*	W2	39
Lantana (Red flowered)	*Lantana camara*	W3	9
Nodding thistle	*Carduus nutans*	W2	37
Nodding thistle	*Carduus nutans*	W3	3
Paterson's curse,Vipers/Italian bugloss	*Echium* spp.	W2	12
Paterson's curse,Vipers/Italian bugloss	*Echium* spp.	W3	41
Perennial ragweed	*Ambrosia psilostachya*	W2	4
Perennial ragweed	*Ambrosia psilostachya*	W3	1
Prickly pears	*Opuntia* spp.	W4f	137
Saffron thistle	*Carthamus lanatus*	W3	1
Scotch/English broom	*Cytisus scoparius*	W2	48
Scotch/Illyrian/Stemless thistles	*Onopordum* spp.	W2	26
Scotch/Illyrian/Stemless thistles	*Onopordum* spp.	W2/W3	1
Scotch/Illyrian/Stemless thistles	*Onopordum* spp..	W3	11
Serrated tussock	*Nassella trichotoma*	W2	41
Serrated tussock	*Nassella trichotoma*	W3	6
Spiny emex	*Emex australis*	W2	2
Spiny emex	*Emex australis*	W3	13
St John's wort	*Hypericum perforatum*	W2	113
St John's wort	*Hypericum perforatum*	W3	8
Water hyacinth	*Eichhornia crassipes*	W1	108
Water hyacinth	*Eichhornia crassipes*	W1/W2	1
Water hyacinth	*Eichhornia crassipes*	W2	16
Water hyacinth	*Eichhornia crassipes*	W3	12

Appendix 2 Listing of NSW Noxious Weed Category Definitions and Action Required

Order No.13 29 January 1999

Category	Actions
W1	The presence of the weed on land must be notified to the local control authority and the weed must be fully and continuously suppressed and destroyed.
W2	The weed must be fully and continuously suppressed and destroyed.
W3	The weed must be prevented from spreading and its numbers and distribution reduced.
W4a	The weed must not be sold, propagated or knowingly distributed and any part of the weed must be prevented from growing within 3 metres of the boundary of a property.
W4b	The weed must not be sold, propagated or knowingly distributed and any existing weed must be prevented from flowering and fruiting.
W4c	The weed must not be sold, propagated or knowingly distributed and the weed must be prevented from spreading to an adjoining property.
W4d	The weed must not be sold, propagated or knowingly distributed and the weed must be removed if it is: 3 metres in height or less, or within half a kilometre of remnant urban bushland, as defined by SEPP 19, and is not deemed by council as having historical or heritage significance.
W4e	The weed must be fully and continuously suppressed and destroyed. All reasonable precautions must be taken to ensure produce, soil, livestock, equipment and vehicles are free of the weed before sale or movement from an infested area of the property.
W4f	The weed must not be sold, propagated or knowingly distributed. Any biological control or other control program directed by a local control authority must be implemented.
W4g	The weed must not be sold, propagated or knowingly distributed.

THE USE OF INFRINGEMENT NOTICES REGARDING WEED CONTROL AT MACLEAN SHIRE

Ian Tye
Chief Weeds Officer
Maclean Shire Council
Maclean

BACKGROUND

With the adoption of the Noxious Weeds Act in 1993, the ability to issue infringement notices was introduced (and regulated a short time afterwards).

After I completed a legal Workshop, Council compiled a new weeds policy to conform with the new Act. When consideration was given to the incorporation of on the spot fines, it was agreed that there was no place for them in this Shire.

It was believed that we could continue with carrying out the weed control by serving Section 20 entries to clean up the weeds. We knew we would need to prosecute the odd one who didn't pay up. Everything had been going okay and under the new Act we could now charge for the cost of the reinspections. We thought that this charge would be handy with those that keep doing just enough control to make you hesitate prosecution.

We were wrong, the General Manager had a number of representations from landholders complaining about a $25 or $45 reinspection charge. The reinspection charges were costing more than it was worth and took lengthy staff time to process. Some charges were close to $200, but none were over that. The work in recovery just wasn't justifying the cost. Others might find it different, but that's what we found at Maclean

Added to this was the difficulty in collecting the costs of the Section 20 entries. Most entries were between $500 to $6,500. Maclean, being a small Shire, wasn't using a dept collector at the time and all that work came back to the staff to carry out.

Council also insisted on the Section 20 entry in the first instance and I certainly agreed with this for some years. Council considered prosecution as a last resort and it was always to late to take action when the matter came to my notice. This again made collecting very difficult as it is a lot easier if you already have a conviction. The crunch really came when we had to make a compromise on one old entry case, it lead to the only loss of funds. It was very little, but came at a time that Council lost a number of costly cases and assisted in Council changing their (and my) attitude.

A revision of Councils Policy in 1996 allowed for prosecution before entry. It also allowed for fines to be imposed. I still wasn't that keen on fines and had missed out on the round of training sessions with other weedies. I eventually attended a SEINS training session in May 1998.

Procedures

The following is a summary that is sent out with each letter or notice:-

INSPECTION PROCEDURES

No set procedures are in place. However, most inspections can expect the following guideline to be followed.

Step A

Oral notification: Form 1

Written notification: Form 2

Please note:- The Inspector is not required to give notice if entry is required urgently and Council has authorised the Inspector to enter without notice.

If noxious weeds are found to be present on the premises, the occupier may be issued with a Form 3 (warning letter) or Form 4 (Section 18) notice depending on a number of factors. **If a warning letter or notice is served, control will be expected to be prompt and effective or firm action will be instigated to ensure treatment is carried out.**

Step B

When a Form 3 (warning letter) or Form 4 (Section 18) notice has been issued a follow up inspection of premises will be carried out with the following action:

1. Control carried out:- no further action. **But, if a future inspection shows that the weed has not been controlled according to it's control category, Conncil will issue an infringement notice, or prosecute the occupier for failure to control noxious weeds.**
2. Incomplete control:- a Form 4 (Section 18) notice and a infringement notice may be issued, or action may be taken to prosecute the occupier for failure to control noxious weeds and/or failure to comply with a Section 18 notice .
3. No control:- a Form 4 (Section 18) notice and a infringement notice may be issued, or action may be taken to prosecute the occupier for failure to control noxious weeds and/or failure to comply with a Section 18 notice .

Step C

When a Form 4 (Section 18 notice) has been issued in Step B, a further inspection of the premises will be carried out and the following action will be taken:

1. Control carried out:- no further action. **But, if a future inspection shows that the weed has not been controlled according to it's control category, Council will issue an infringement notice, or prosecute the occupier for failure to control noxious weeds.**
2. Incomplete control:- another Form 4 (Section 18) notice and a infringement notice may be issued, or action may be taken to prosecute the occupier for failure to control noxious weeds and/or failure to comply with a Section 18 notice .
3. No control or inadequate control:- an infringement notice issued and another Form 4 (Section 18 notice) may be issued, or a Form 5 (Section 20) notice of entry to control noxious weeds may be issued and/or action will be taken to prosecute the occupier for failure to control noxious weeds and/or failure to comply with a Section 18 notice .

Step D

Following the issue of a Form 5 notice:- entry is made after 24 hours from the service of the notice to premises (in accordance with Section 20 of the Act) to carry out control of noxious weeds by Council staff or persons authorised under the Act. The full costs of control work will include all

materials, plant, labour (including on-costs) and/or contractor account. Supervision of work will be charged to the occupier and all costs, until paid, will become a charge on the land (under Section 60 of the Act). If any accounts for fees, charges and expenses incurred under the Act are not paid within 30 days after the date of the account.

a) interest will accrue on the unpaid account at the rate of 10% per annum, and
b) Council will commence proceedings for the recovery of all unpaid amounts.

These procedures are in Councils General Noxious Weeds Policy and we endeavour to adhere to the guidelines as close as possible. However, it is always stressed in each SEINS course that much is up to your discretion. You have to stand any flack and must be comfortable with and be prepared to defend your decision. With weeds there are far more varying issues when you compare it to a parking or a dog off a lead fine!

On most occasions, if a landholder has not carried out their work or made a poor effort, it is reported to me by the inspector. We discuss the circumstances and background and jointly decide what action is required. (In each case it has been made clear in the prior notice that is being acted on that a fine will be imposed if the treatment is not fully carried out.)

If a fine is warranted, we both make a joint inspection, preferably with the landholder present (always good to get them in a photo at some stage). If we do see the owner, we make it clear why the inspection is being made and what our intentions are. This is often enough to get the desired effect! If a satisfactory outcome does not occur we then collect the evidence by way of photos, diary notes, and sketch the expanse and location of the infestation. All this evidence is kept in a file until court or the fine is noted as paid.

We will again discuss the matter in private and ensure that we both feel the decision being made is the right one in this particular case. I then attempt (if time and circumstances allow) to meet with or phone the occupier to inform him/her on what action is to being taken. All further contact in relation to the fine is handled by the Infringement Processing Bureau.

A letter is sent out with the infringement notice further explaining the action and informing the landholder that even more costly action could have been taken. We mainly aim to cover reinspection costs plus a bit as a deterrent. The set letters all finish with:-

Any inquiry concerning the infringement notice should be directed to:-

Executive Director
Infringement Processing Bureau
PO Box 5555
Parramatta NSW 2124

Council and staff regret having to take this cause of action. However, Council has incurred costs through your inaction and must ensure that the requested control is made in order to benefit all landholders in the Shire.

If an objection is sent by mail to Council, it is returned and Council requests they forward it on to SEINS. When the letter is sent to the Bureau, they in turn then contact us with the letter stating that "written representation" has been made. The contact officer must then decide on whether the penalty is to stand, place a caution or take no further action.

Naturally you get a few phone calls, but you just advise them to write to SEINS or take their opportunity with the court option. You have to hold your ground at this point and explain the aims and intentions of the action. Lets face it, no one likes fines.

We have issued one of the fines for "Fail to control noxious weeds" (after sending 2 letters, reminding the occupier to follow up with the first control). We now send a clearance letter to any property that has carried out the required control. The content is as follows:-
I refer to your property on which a notice was issued last year/recently requiring effective control measures to be carried out on certain declared noxious weeds. The property has now been inspected and the work required has been carried out. The position regarding the infestation of noxious weeds is acceptable and no notice will be issued at this time. Council wishes to express its appreciation for your cooperation in the matter.

There are, however, a number of matters which Council wishes to draw your attention. Besides noxious weeds adverse affects on pasture, they have a number of other unpleasant characteristics, among which are:

(a) they will spread prolifically unless strictly controlled;

(b) once established they are difficult and expensive to control; and

(c) regrowth is always likely to occur, even in the year following effective control measures have been carried out.

Council wishes to particularly draw your attention to item (c) as annual maintenance and control is essential otherwise the situation will quickly progress back to item (a) and then the occupier will again be faced with item (b).

You will appreciate that this will mean your original financial outlay will be virtually wasted. Therefore, the situation should be monitored annually to ensure the position does not deteriorate, annual maintenance costing far less in the long term.

The control of noxious weeds from private property is primarily the responsibility of the occupier. Council's duty is to draw infestations to the occupiers attention and ensure that corrective measures are undertaken. Your land has now a history of the noxious weeds that have been brought to your attention. If you fail to control the weeds at a latter date, as requested above, Council staff has no other alternative but to fine or prosecute you for "Failure to control noxious weeds". This action is outlined in Councils noxious Weeds Policy The on the spot fine will amount to $200. If Council were to choose to prosecute you the penalty could be as high as 4,000, if proven.

Please feel free to contact me on the above number if you require any further information in regard to this matter or any weed identification or control.

The reminder makes it very clear that they must follow up with yearly control action or they will risk being fined for "Failing to control noxious weeds". Unfortunately there are many cases where landholders here ignored this advice in the past. They represent a major spread threat to both

Council and their neighbours. Our major weed problem, Groundsel Bush, only takes a short time to return and yet you can be easily rid of the weed with a good 3 year control program.

Conclusion

I was very surprised to be asked to speak on this topic. There are many others who have far greater experience in this field than I. I've certainly never been comfortable with issuing the fines and even less so writing an infringement notice!

One thing is for sure though, they are getting the desired effect and I can't see doing my job without them any more. People who have often been uncooperative in the past are now cleaning up their weeds before we get to them. That was clear with the recent aerial inspections.

We have served a total of 28 fines and only 3 of these have been withdrawn (or no further action). Two of these would never have been stopped, except I was on leave and the contact officer had no idea of the Noxious Weeds Act. So, in my absence, he choose not to proceed. The other one was withdrawn over a discrepancy with a boundary that would have made the case difficult to defend.

The most pressing point I can raise is that it is critical that the person that is designated as the contact officer has a good understanding of the Act and keeps you fully informed . It can also lead to the income from the fines being "lost in the system", which gives little point to the exercise.

Most landholders want weeds cleaned up and if they fall behind or don't cooperate, they would rather a fine than turn up at court. It is far less embarrassing to some, while others thrive on the "confrontation" in court. You are simply catering for their ego! They can still go down that track if they want, but most realise they have committed the offence and would be wasting their time and money.

Added to this is the fact that most court action ends up with penalties that aren't much more than if you had fined them! A $500 fine for a person who has blatantly refused to control their weeds and allowed them to spread to adjoining lands is crazy. The amount of time you spend in preparation and, even with a "perfect" case, it is all up to the magistrate which way he goes.

Take home message

Your Council should have the option of issuing SEINS infringement notices adopted into their Weeds Policy. You may not even serve a fine or maybe do just once a year, but you will be able to if the case arises! It works and should be considered by all Councils. You may never like writing them out, but once you do you will find it will save a lot of work in the long run.

All Shires have their uncooperative landholders who will buck their obligations under the Act. Avoiding them is not the answer and pestering them into submission is a simple waste of valuable time. A fine is the easiest way to get the desired action. I'm sure many would be surprised at the amount of support they would get from the good farmers if they took up this action.

INTEGRATED CONTROL OF BITOU BUSH

Ken Hayes
Chief Weeds Officer
Coffs Harbour City Council

The control of Bitou Bush started in earnest in the winter of 1994. A series of public meetings were held in Coffs Harbour to inform the public of planned Bitou Bush aerial control. There were a few concerns to address before spraying could start. The main concern was being voiced by the local Toxic Action Group and the North Coast Environment Council about spray drift. It was agreed at the meeting that the NSW Health Department would place air monitors at 0, 15, 30 and 50 metres from the sprayed areas. These monitors proved to be inconclusive due to a delay in analysis. All monitors showed levels below the US EPA Reference Dose of 001mg/kg/day. This process was repeated in the 1995 spray programme.

Twenty hectares of Boambee Beach was aerially sprayed on 27 April 1994 with Roundup @ 2litres/Ha in 30L of water when 4 x 5 hectare plots over a 40 hectare area were sprayed, ie spraying 5ha and leaving 5ha as a control. These 4 x 5 ha plots were called plots 1, 2, 3, and 4. This spraying was done in co-operation with John Toth who was then working for the Department of Agriculture.

It was decided that we would aerially seed two of these plots (1 and 2) with Coastal Wattle seed (acacia sophorae) at approximately 1kg/Ha. As this had never been attempted before, I decided to pour boiling water over 5kg of seed to break the seed coat for application and leave 5kg natural. We did not have a seeder at the time so we strapped a length of 8" plastic water pipe to the landing strut and the door frame of the helicopter of which the door had been removed.

I then sat in the second seat with two buckets of seeds and tossed handfulls of seed down the pipe as we flew backwards over the two plots. However, the seed which we had soaked was very damp and tended to stick to the sides of the pipe even when we mixed 50% dry and 50% moist seed.

Six months later, two transects were slashed on each of the four plots, 2m wide and approximately 100m long at right angles to the flight path (east-west). Within each of these transects 50 x $1m^2$ quadrats were placed and the emerged seedlings of Coastal Wattle were counted and recorded.

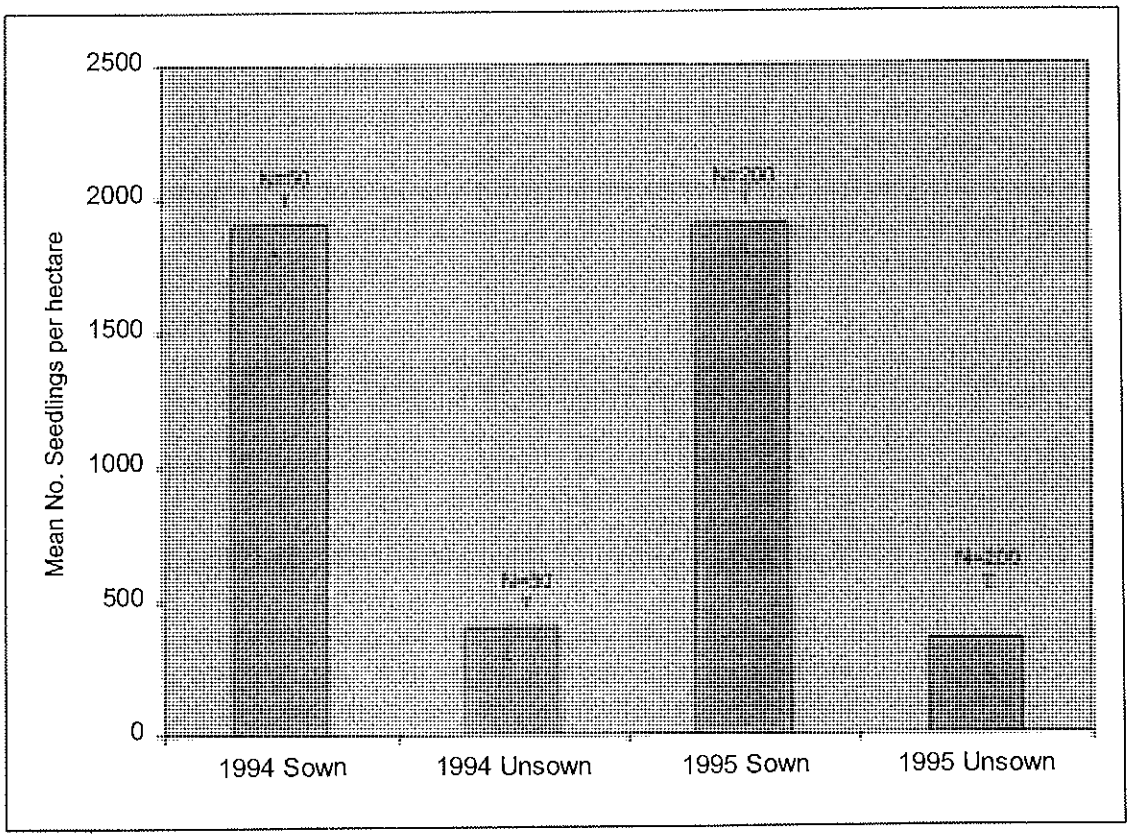
1995 Bitou Bush Programme

Once again 4 x 5ha plots were sprayed with Roundup @ 2 litres/Ha. During the past 12 months John Toth had developed a seeder that was placed on the spare seat of the helicopter beside the pilot. The Coastal Wattle seed was applied @ 1kg/Ha at the same time as the herbicide application hence saving extra flights over the trial plots. Once again two of the sprayed plots were seeded with dry seed and two were unseeded. The new seeder performed perfectly.

Six months later two transects were slashed across the spray passes on each of the newly seeded and sprayed 5 ha plots and the unseeded and unsprayed 5ha plots. There had been a problem with the 1994 trial where nearly all of the emerged seedlings of Coastal Wattle within the slashed transects were eaten by rabbits or wallabies. The quadrats in the new trial were placed out of the slashed area

on top of the intact dead Bitou Bush, and the Coastal Wattle seedling visible within the quadrats were counted and recorded. To improve the accuracy, 200 x 1m² quadrats were placed on both sides close to the edge of each slashed transect. These results taken by John are as follows:

Establishment of coastal wattle (A.sophorae) 6 months after sowing in 1995 and 1996 (seedlings ha $^{-1}$. Results have been derived from initial quadrats counts (1m²) along transects in each treatment. Mean number of seedlings per hectare. Error bars indicate Standard Error of the Mean. n = number of quadrats per transect.



With the results of these trials, I would not recommend burning the Bitou Bush after it has been sprayed and seeded because of the damage to the existing and seedling native species.

John also trialled this dual application of spray and seed at Ballina in 1996 with a mixture of native plant seeds ie Coastal Wattle, Sword grass (Lomandra multiflora), Tea tree (Leptospormun laevigatum) and Banksia (Banksia integrifolia) with considerable success.

Armed with this knowledge, we sprayed another 55 Ha in 1996 at Boambee Beach. We sprayed 5Ha using Roundup B1 Active @ 2 litres/Ha, 5Ha using Roundup DF @ 1kgHa, 5Ha using cut out @ 300gm/Ha, 5Ha using Trounce @ 800 gm/Ha, 5Ha of Roundup @ 2 litres/Ha and 15 Ha using Brushoff @ 30gm/Ha.

The results of this trial clearly showed that Roundup and Roundup Biactive @ 2 litres/Ha and Brushoff @ 30gm/Ha were the only suitable herbicides to use.

My personal preference would be to use Brushoff @ 30gm/Ha because of the Bitou Bush seedling suppression that it gives over Roundup which has none. However, there has not been enough research done on the susceptibility of native plants when using Brushoff, where we know that there are now about 180 native species that are tolerant to Roundup @ 2 litres/Ha when sprayed in the winter period.

The spray drift trials were again carried out by Geoff Sullivan of the NSW Health Department, Lismore, on 26 June, using five Gilian Gil-air, constant flow air sampling vacuum pumps placed at 0, 10, 25, 50 and 500 metres from the sprayed plots and the results from the analysis of the fitter membranes indicated the residues to be greatest at the site inside the target area and progressively decreasing away from the target area and quickly falling to near the level of detection at a distance of 25 metres from the site.

The detected concentration of Glyphosate are all below those used as an international yardstick to measure potential health risks.

Site	Pump1	Pump 2	Pump 3	Pump 4	Pump 5 (Field blank)
Flow rate L/min	2.0	2.0	2.0	2.0	2.0
Time Mins	150	150	150	150	150
Total Volume(L)	300	300	300	300	300
Cassette Lab ref	950697	695698	950699	950700	950701
Lab result ug/cassette	43.0	24.5	0.55	0.08	0.08
Tube Lab ref	950702	950703	950704	950705	950706
Lab result ug/tube	ND	0.05	ND	ND	ND
Total cone ug/m³	43.0 x 0.3 = 143.33	24.55 x 0.3 = 81.83	0.55 x 0.3 = 1.83	0.08 x 0.3 = 1.83	0.08 x 0.3 = 0.267
*24 hour inhalational exposure ug/kg/day	.055	0.03	.0007	.0001	.0001
Distance from Spray (m)	0	10	25	50	500

* calculated for 10kg child inhaling 3.8m³ air over 24 hours

To further our knowledge of the species range tolerant to Brushoff, 110 Ha of Boambee Beach was sprayed on 7 May 1998. 50Ha using Roundup @ 2 litres/Ha and 60Ha using Brushoff @ 30 gm/Ha. 25Ha in each area was re-seeded with Coastal Wattle.

Twenty transects were then slashed into the seeded plots, ten in the Brushoff and ten in the Roundup sprayed and seeded areas.
John Toth was able to source some funds from the Department of Agriculture for a vegetation study of the area which was carried out by Mr Alex Floyd. His observations on the sprayed areas means that we now have 90 native species that are tolerant to Brushoff at 30g/Ha aerially sprayed in the winter period.

Coffs Harbour City Council's Noxious Weeds section will be aerially spraying and seeding approximately 60Ha of Bitou Bush in 1999 beginning on the City's northern boundary at Arrawarra and working south to North Sapphire.

GRASSHOPPERS, GLORY LILY AND GREENCORPS

Bitou Bush Management in Clarence Valley National Parks.

Jeff Thomas
Pest Management Officer
New South Wales National Parks and Wildlife Service, Grafton

INTRODUCTION

The Grafton District of the New South Wales National Parks and Wildlife Service (NPWS) manages approximately 80km of coastal land on the north coast of New South Wales within Bundjalung and Yuraygir National Parks and Iluka Nature Reserve (Figure 1).

Virtually all the coastline is infested with bitou bush *(Chrysanthemoides monilifera ssp rotundata)* to some degree. Only about 1.5km is considered to be free of bitou with another 7km of minor infestation. (Thomas, 1997) Large areas of adjoining vacant crown and council land, including lower Clarence River estuarine islands are also infested.

Infestations are generally confined to a narrow coastal strip less than 500m in width with occasional outliers alongside roads or other areas subject to gross disturbance. Bitou bush occurs on both fore and hind dunes and headlands and is particularly prevalent on approximately 18km of land previously subject to mineral sands extraction. Bitou bush was used to stabilise sand and revegetate dunes after mineral sands extraction from the 1950's to the early 1970's. (Holtkamp, 1996)

The impacts of bitou bush in this area are similar to those outlined in Weiss *et al* 1998. In many areas it can achieve close to 100% cover and exclude most other vegetation. Many areas of high conservation value such as the World Heritage Listed Iluka Nature Reserve are affected by bitou bush.

MANAGEMENT

Bitou bush is one of a number of pests, both plant and animal, which affect areas managed by NPWS. A District wide pest strategy has been prepared (Thomas, 1997) as a mechanism to identify and address the range of pest management issues in the local area. Bitou bush is regarded as one of the highest priorities.

The management strategy for Bitou bush has the main objective of protecting natural areas by establishing and maintaining core areas where bitou is in an insignificant component of the vegetation, and extending these areas as resources permit.

Specific actions under this strategy are:

- control/eradication in areas of low infestation with the aim to maintain good examples of naturally vegetated dune vegetation (eg .Station Creek beach) and to reduce its spread;
- control in identified higher conservation value areas, eg. *Themeda* grass headlands and littoral rainforest (eg Iluka Nature Reserve),

- engage in partnerships with interested local community groups, eg dunecare, to undertake work,
- participate in the biological control program,
- develop and implement control programs with neighbouring land managers eg councils,
- seek additional funding and resources for program implementation.

Grafton District began a concerted effort to control bitou in 1992 with the spraying of individual bushes and isolated patches in a small section of dunes on Station Creek beach and hand removal amongst *Themeda* grass on Iluka Bluff headland.

Choice of control methods considers resources available (financial, human, capital), environmental impact, cultural issues, local site factors such as access and topography, the presence of biological control agents and the outcome required. All methods of control are used including hand removal, herbicide application including cut stump techniques and spraying (high volume, aerial application, knapsack). In the last 2 years burning and mechanical clearing have begun to be used.

In the mid 1990's several factors led to a dramatic expansion of the management program. The development and adoption of aerial herbicide application methods as described in Toth *et al* 1996 and Holtkamp, Toth and Milham, 1998 for controlling bitou bush has potentially led to a much larger area which can be treated at a reduced cost compared with other methods.

Aerial application was first used in Yuraygir National Park at Angourie where 15ha were sprayed in winter 1995. This initial spraying was very effective with a greater than 95% kill. Since that time aerial application has been used each year as part of the annual control program. It has also been used extensively in the adjoining Maclean Council area where over 300ha were treated in 1998 (Ian Tye pers comm) and nearby Coffs Harbour City Council where 130ha (Ken Hayes pers comm.) were treated

The advent of the NSW Government's Resource Package Allocation in 1994 to NPWS provided increased funding for pest control programs and the District has expanded the area under treatment.

The presence of interested community groups at Iluka, Angourie, Diggers Camp and Station Creek has led to the development of partnerships with the local community. Groups with NPWS support have been successful in obtaining funding, especially though the Coastcare program to undertake joint projects in their local section of the national parks.

GRASSHOPPERS

Within much of the control area it is expected that, where there is adequate natural vegetation cover, control of bitou will encourage the native species to regenerate to a level where bitou cannot establish or where it becomes only a minor component of the vegetation. Until recently this was being observed in practice as an outcome of initial control and adequate follow up.

However an outbreak of grasshoppers which was first reported at Angourie at the start of summer 1994 has led to a re-assessment of our expected outcomes with significant management implications.

Grasshoppers were found at Angourie each summer from 1994 to 1997 over an area of about 5ha adjacent to the beach. They were present in the thousands and were eating the foliage of several native species especially *Acacia sophorae* (Coast Wattle) and *Casuarina equisetifolia* (Horsetail Oak). Where defoliation was greater than about two-thirds of individual plants death occurred and it is estimated that 80%-90% of the coast wattle was killed. *Banksia integrifolia* (Coast Banksia) had the younger leaves completely eaten with the margins of older leaves chewed resulting in foliage dieback from salt burn or fungal attack.

This damage was disheartening to the local dune care group as they had been planting thousands of plants for revegetation over the preceding few years only to see many destroyed by grasshoppers. Bitou bush was not eaten.

In the summer of 1998 the grasshoppers moved about 1km south and infested an area of about 60ha and a major impact on the bitou control program resulted. A 15ha area which was first aerially sprayed in 1995 had Coast Wattle regeneration effectively suppressing bitou regrowth over a large part of the site. However the grasshoppers almost completely killed the wattle, allowing the bitou to re-invade the site to a point where it is again the dominant plant again. A wider variety of native species were seen to be eaten, although not to the same extent as the wattle.

At the same time large outbreaks of grasshoppers were seen in the Lake Arragan to Shelley Headland section of Yuraygir National Park, 5km south of Angourie, which had severe effects on a 60ha aerially spayed site and Station Creek, about 60km to the south, where about 80ha of dunal vegetation was affected. Only limited control of bitou bush had taken place in this area. Outbreaks were also reported at Angels Beach near Ballina.

The grasshoppers have been present again in large numbers last summer in the same areas and have spread a small distance south from Angourie. Impacts on Horsetail Oaks and Swamp Oaks (*Casuarina glauca*) were particularly severe at Station Creek this year. Grasshoppers were also seen at Mullaway, about 12km south of Station Creek.

The Australian Plague Locust Commission (APLC) have identified the grasshopper as *Valanga irregularis* which is commonly known as the giant grasshopper or large coast locust. (Dr Graeme Hamilton, Director APLC pers comm).

The APLC advise that the life cycle of the grasshopper is not well understood and it is not known whether the population will persist or could suffer a catastrophe and crash. Control options are very limited especially in a conservation area.

From our experience in the last few years it appears that where bitou bush is present amongst the zone where coast wattle is a major plant the strategy of using wattle as a competitor is not viable. This is a significant problem as wattle is used in many revegetation programs. Where there are many other native plants present, the impacts of grasshoppers are less important.

GLORY LILY

Glory Lily (*Gloriosa superba)* occurs naturally in Africa and Asia and is one of 5 species in the genus (Harden, 1993). It is cultivated as an ornamental in Australia. It is a herbaceous annual climber with subterranean perennial tubers (le Roux and Robbertse 1994).

It is naturalised in Australia in coastal dry sclerophyll forest and sand dunes principally in south-east Queensland and northern New South Wales. (Csurhes and Edwards, 1998, & Thomas, 1998).

Within Yuraygir National Park, Glory Lily is of particular concern where it has increased many fold in the last few years. There is currently no control method which provides both effective control and minimises off target damage, especially for large infestations. Stem densities up to 70 stems per m2 have been recorded.

Removal of bitou bush and coastal weeds commenced in 1995 in the Diggers Camp-Wilsons Headland area of Yuraygir National Park on a 2km section of coastal headland and dunal vegetation. Significant progress has been made in restoring the natural environment in that time.

However the widespread presence of glory lily in the area has led to changes in the restoration strategy for this area. It has been observed that where Bitou bush and Glory Lily are growing together, the removal of bitou bush causes a rapid increase in the amount of Glory Lily. This is an unacceptable outcome as there is no adequate control for Glory Lily. As a consequence control of bitou in the area has ceased where the two plants are growing together.

GREEN CORPS

A crucial consideration in management of all pest plants and animals within the District is the available resources. It is recognised there is a need to look outside the recurrent funding allocated for pest management to increase the amount of work that can be undertaken.

With the support of local community groups, Grafton District has been successful in obtaining three Green Corps projects at Iluka, Angourie and southern Yuraygir National Park. Green Corps is an initiative of the Commonwealth Government which is managed by the Australian Trust for Conservation Volunteers.

A project team consists of ten 17-20yr olds for 6 months. They undertake hands on conservation work, community service and training and come with a qualified supervisor. The District has used them in various landscape restoration, park construction, bush regeneration and weed control work.

The availability of these teams means an expanded range of options is available to manage weeds. They have been used to remove bitou bush in remote areas, cut access tracks to facilitate later spraying, follow up on previous weed control treatments and undertake intensive revegetation including propagation, planting, erosion control and fencing.

While these teams require a commitment from NPWS staff to be implemented successfully the outcomes of projects have led to an improvement in the restoration of natural environments and the sustainable recreational use of the parks.

TAKE HOME MESSAGE

When managing weeds many factors can influence the success or otherwise of programs. The examples outlined above illustrate the continual requirement:

- to be prepared to adopt a flexible response to changing circumstances;
- to look at managing the impact of the weed rather than weed itself,
- to be aware of non-traditional opportunities to help manage weeds and
- if possible, have the local community involved in your work.

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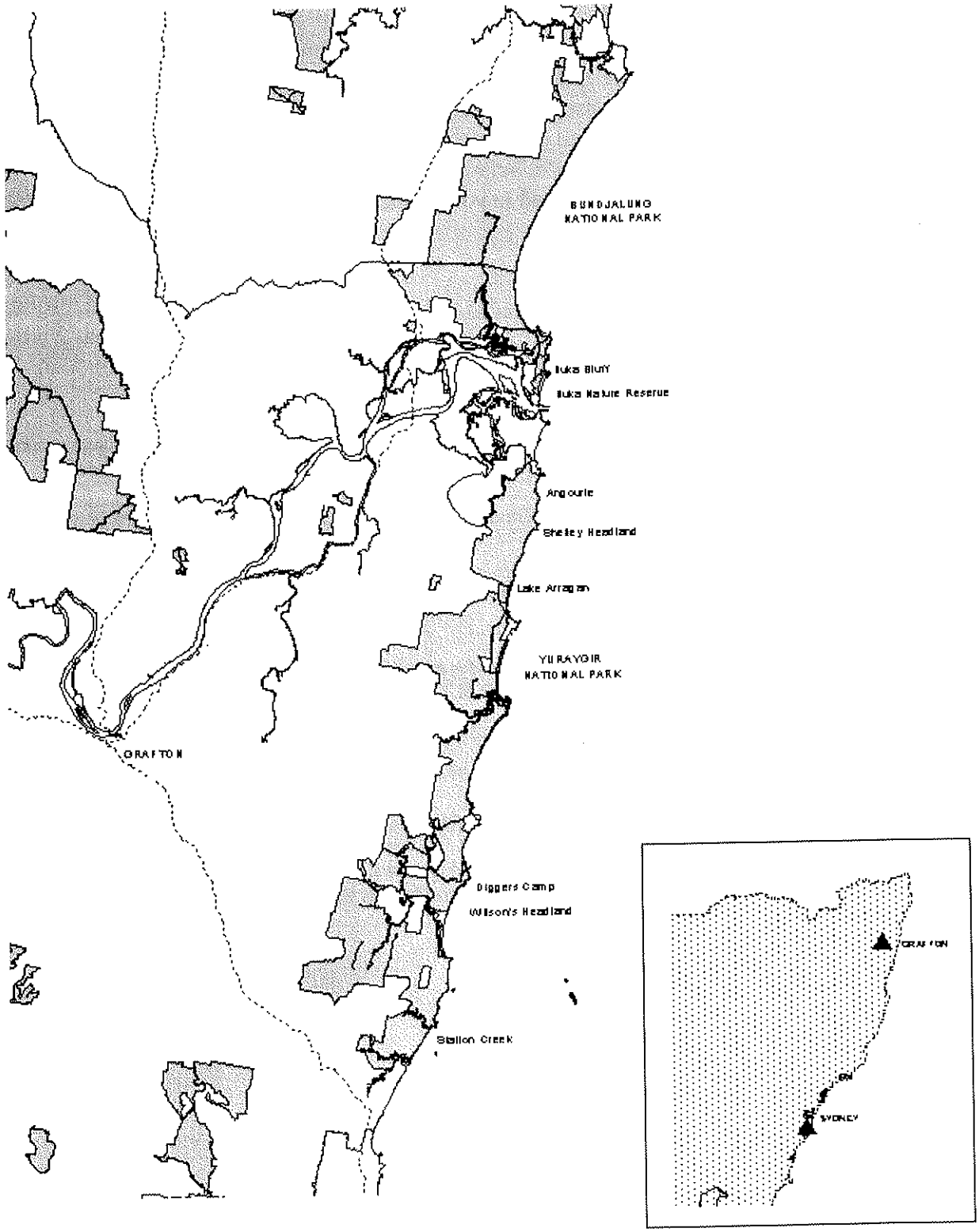

Grafton District Boundary
Major roads
Coast
NPWS Estate

Yuraygir and Bundjalung National Parks

Created By
Bill Salsom, Grafton District
13 May 1999

ROADSIDE MANAGEMENT AND WEED CONTROL
Case studies on Bellingen and Nymboida Shire's

Tim Scanlon
Environmental Consultant
Coffs Harbour (previously Bellingen and Grafton)

BACKGROUND

What is a Roadside Management Plan? It is a Plan of Management to address and co-ordinate ALL issues affecting roadsides. They are not directly about the road surface itself but focus on the rest of the roadside. As Roadside's mean something different to everyone, everyone must have a say in how they should be managed. As opinions, technology and issues change, the Roadside Management Plan must be updated from time to time to reflect these changes.

What does it have to do with weed control? It has a lot to do with weed control because there are many activities that Council and public utility staff and others do on roadsides that actually spread more weeds. For example, when roadside workers 'clean up' the site when they're finished their roadworks by pushing dirt over the side of the hill it means coming back to the site and controlling the weeds. Roadside Management Plans attempt to reduce the spread of weeds so that there is lees to control in the future.

Why are they done? Over 40 Shire's in New South Wales and most Victorian Shire's have implemented Roadside Management Plans. They are done for 3 main reasons:

They can save money. Some Shire's have been able to save as much as 2% per year on Road Construction costs since implementing Roadside Management Plans. One of the main ways to save money is by not having to come back to the job and fix the problems you've created. Another is by only doing what you have to do. Don't slash from fence to fence on wide road reserve's when visibility is good. Mark out the construction area before you start any work because there is no need to be clearing huge areas when you don't have to. Weeds love soil disturbance so the less area disturbed, the less weeds. Noxious weeds must be controlled by law and environmental weeds often grow faster than natives so they can either cost you money to slash them or they pose a visibility / fire hazard.

Legislation. There are a lot of laws affecting roadside workers and there's more coming all the time. Roadside workers should not be expected to know the in's and out's of all of the latest legislation and international agreements; a Roadside Management Plan describes what they should or should not do to follow the law.

Major weed infestations, rare or special plants, historic marker posts and Aboriginal significant sites can all be marked on a map that roadside workers have with them. When slashing the roadside they then know to look out for the historic marker post '1 km up the road near the letter box' or they can start slashing from the least weedy end of the road so that they are not spreading noxious weeds up the roadside. Council's are finding more and more pressure to ensure that these Acts and regulations are not broken - breaking the law can make you un-popular and it can be costly.

Find out what Council's assets are and what the people think are the biggest issues affecting their roadsides. For the first time the Council has a Plan of Management that addresses all of the issues important to the community, stakeholders / government departments and the Council staff that work on them.

Where are the main weed problem areas and what areas could be improved with just a bit of management? Where are the safety problem areas and the main tourist routes? All of this information can be included in the Roadside Management Plan.

The preparation of a Roadside Management Plan is usually a 3 step process:

1. Assess what is there and what people think;
2. Plan what needs to be done to address any problems, and;
3. Implement it!

THE BELLINGEN AND NYMBOIDA SHIRE COUNCIL'S ROADSIDE PLANS

Bellingen and Nymboida Shire Council's are the first Council's on the North Coast to implement Roadside Management Plans. Both Shire's support a dramatic range in topography from broad river floodplains to high mountains up to 1400 metres. Bellingen Shire also includes coastal areas around Urunga and Mylestom. Both Shire's have a large number of roads to maintain and a low population so strategies to reduce the spread of weeds need to be cost effective.

Before the Roadside Plan Bellingen Shire was under a lot of criticism from the community and there was a lack of trust regarding the use of herbicides to control weeds. The Shire has a mild climate and a high rainfall so roadside weeds were a problem. For example, the roadside surveys revealed that 50% of all roadsides supported Small-leaf Privett.

Nymboida Shire has very little money to do anything on roadsides. This meant that very few roadsides were slashed, leading to safety problems, but because there was often 2m tall pasture grasses and 4m tall trees on all roadsides, there was fewer weeds due to competition and a lack of light reaching the ground. Fire and visibility can be a problem in these areas but when native vegetation is established there are few groundcovers so there is good visibility, few grazing kangaroo's and a relatively low fire risk.

Roadside Vegetation Categories

All roadsides maintained by Council in Bellingen and Nymboida Shire's were surveyed by myself with the help of farmers, landcare groups, Greening Australia and Green Corps, botanists, Rural Fire Brigade representatives and other members of the community. Every weed observed on the roadside was noted as well as how common it was and whether it was also on the adjoining land. The survey also noted dominant or significant native plants on the roadside (only); adjoining land use; the width of the road reserve; habitat values such as creeks or tree hollows; regeneration; stockpile sites; safety problem areas etc. From this information roadsides received a score out of 30 so that they could be given a category: A, B or C. A category roadsides (21-30 points) were often wide, had very few or no weeds, had bushland on the adjoining land and contained habitat values. B category roadsides (11-20 points) were often a mixture of native vegetation and weeds. C category roadsides (0-10 points) were often either pasture grass or weeds. The other category assigned to

roadsides was Special Management Areas where there may be Rare plants, Historic sites, Aboriginal significant sites or other features such as Scenic values.

Some weed strategies covered the whole Shire whilst others were developed for the different roadside vegetation categories. The idea being that where roadside vegetation is in good condition and it is left alone as much as possible (except for safety clearances), few weeds will grow. In B category areas the weeds need to be controlled but the native vegetation should be encouraged. C category roadsides are generally high maintenance roadsides where pasture grasses need to be slashed and weeds need to be controlled.

Areas of the Bellingen Shire very clearly highlight the valuable role of shade and competition as a weed control. On one roadside where I was surveying I noted continuous Giant Parramatta Grass until, a couple of hundred metres up the road, there was none! It had been shaded out by Small-leaf Privet! As I drove further up the road it too disappeared; shaded out by Camphor Laurel! Eventually it was also out-competed by native vegetation a little further up the road. Most weeds require light to germinate so in areas where native vegetation is present and in good condition, the best thing you can do is leave it alone.

The Strategies

In Bellingen Shire the first strategy for weed control was to involve the community. Meetings have since occurred where the community are notified about what control methods are to be used. Organic properties are able to register with Council and in some areas weed control is undertaken by the community. For this to occur, these properties must know that under the Noxious Weeds Act, noxious weeds must be controlled. Information on various control techniques can be given to them by Council. The other thing that needed to happen was for the rest of the community to see that it doesn't matter which control methods are being used, as long as the weeds are being controlled.

The main strategy for weed control is that it had to be integrated. Weed trials and advise from experts clearly highlighted that when several control methods were used in conjunction with each other there was more success. The control methods used depended on factors such as the topography and amount of vegetation. In Category A and High Conservation Value roadsides weed control should be done on foot in most situations, remembering that very few weeds were found in these roadsides.

Maps highlighting the Roadside Vegetation Category, Special Management Areas and the distribution of Giant Parramatta Grass were circulated to all Council staff in both Shire's as well as Telstra, North Power, Rural Lands Protection Board and the Rural Fire Brigade. Staff have been encouraged to slash from the least weedy areas to the most weedy, hose down or brush off before leaving heavy weed infested areas and look at the Vegetation map before spraying herbicide. Council staff in Bellingen Shire have also been encouraged to slash A category roadsides more in late Summer and Autumn to give time for native grasses to set seed. In Category C roadsides slashing should occur more in Spring and early Summer, not Autumn, to reduce seeding and so that weed seeds are not spread as much. Bellingen Shire has also been utilising rope-wick applicators as a method to control Giant Parramatta Grass and tall growing pasture grasses in areas of poor visibility.

Implementation

To help implement Roadside Management Plans there is a need for official training. Bellingen Shire is planning roadside training for all outside and some indoor staff in the near future. Nymboida Shire has submitted a Natural Heritage Trust Application to undertake roadside training with Ulmarra (who are nearly finished their Roadside Management Plan), Grafton, Copmanhurst and Maclean Shire Council's as well as staff from Telstra, North Power, Rural Lands Protection Board, Rural Fire Brigade and Landcare groups (through the ClarenceCare Co-ordinating Committee). The main focus of the training is to encourage staff and community members to minimise impact when undertaking any roadside activities.

Bellingen Shire have employed a Vegetation Officer who co-ordinates weed control activities, undertakes property inspections, encourages community involvement and works with Council staff. Nymboida Shire is in the process of forming a Regional Weed Control team with other Lower Clarence Shire Council's. Nymboida Shire has been implementing Roadside Management practices during maintenance and construction works well before I commenced work with them and it is managed by the Shire Works Engineer.

FURTHER INFORMATION

Information regarding the formation of Roadside Management Plans and related issues can be obtained from:

NSW Roadside Environment Committee
P.O Box 470, 160A George Street
WINDSOR, NSW 2756
Phone (02) 45877564, Fax (02) 45776236

Tim Scanlon
1/107 Ocean Parade
COFFS HARBOUR, NSW 2450
Phone (02) 66524003

Peter Lane,
Nymboida Shire Council
P.O Box 51,
SOUTH GRAFTON, NSW 2460, or
Phone (02) 66421866

Ian Turnbull,
Bellingen Shire Council,
P.O Box 117,
BELLINGEN, NSW 2454
Phone (02) 66557338

ROLE OF REGIONAL WEEDS ADVISORY COMMITTEES

Peter Gray
Noxious Plants Advisory Officer
NSW Agriculture
Dubbo

Regional Weeds Advisory Committees (RWACs) are playing an increasingly important role in the control of noxious weed in NSW. They provide an opportunity for increased coordination cooperation withi9n regions as well as providing a vehicle for the distribution of information.

These committees originally developed from local initiatives and differ considerably in their membership, objectives and mode of operation. They operate independently of each other, and until last years workshop, had with little or no knowledge of each other's operations.

Last year the Noxious Weeds Advisory Committee sponsored a workshop in Sydney which was attended by representatives of each of the committees. The objectives were:

- to facilitate the adoption by RWACs of the best aspects of other RWACs
- to identify opportunities for further improvement
- to create an environment where RWACs will be actively supported by council management

A session has been set aside at this conference to allow members of the various committees to further discus these issues and to provide feedback as to what benefits they achieved from the Sydney workshop.

Peter Gray
N P A O
Dubbo

SUCCESS OF REGIONAL WEED ACTION PROJECTS
Regional Weed Management Strategy for the Hunter and Central Coast

Eddie Lanting
Field Superintendent
Gosford City Council

Dale Moore
Vegetation Control Officer
Lake Macquarie City Council

Project Aim

To develop and implement a more cooperative and collaborative approach to weed management in the Lower Hunter and Central Coast Region. This is to be achieved through the development of a Regional Partnership Agreement that will be endorsed by the ten Councils within the region.

Background to Regional Coordination and Cooperation

A Committee was established in the Lower Hunter and Central Coast region of New South Wales in the early 1980's to combat the emerging threat posed by *Alternanthera philoxeroides* (Alligator Weed). This committee sought to coordinate efforts to deliver viable and effective control methods for Alligator Weed and create public awareness of the risks posed by uncontrolled spread of the plant.

The Lower Hunter and Central Coast Noxious Weeds Advisory Committee was formed in April of 1990 when the focus of the Alligator Weed committee expanded to include a wider range of weeds. The aims of this Committee were to:

- Promote a coordinated approach to noxious weed control within the region.
- Identify and monitor potential weed problems within the region.
- Identify noxious weed control needs and priorities and seek funding for research.
- Carry out research programs relating to weed control.
- Carry out awareness and publicity programs within the region.

Promotional material developed by this Committee was used for all competitions during Weeds Awareness Week 1996.

Why Introduce a Regional Partnership Agreement

The Committee hopes to overcome a perceived lack of commitment for Committee actions from member Councils. While the existing Committee continues to meet and discuss weed control on a quarterly basis, the lack of Management and elected Councillor representation as well as the lack of

a formal agreement makes it difficult for the Committee to take any action that would have an impact upon the Councils.

In addition the ever-increasing trend towards a catchment, regional or state focus when dealing with many issues including weed control is a further reason to pursue a regional agreement. This is highlighted by NSW Agricultures recent initiatives to fund Regional Weed Action Programs and Regional Weed Control Plans.

Action Plan and Regional Partnership Agreement

The Committee submitted a Regional Weed Action Program Proposal in November 1997 seeking $28 000 to appoint a coordinator for the year 1998-99. The submission was successful and the Committee employed a coordinator on a part time basis to develop and implement a Regional Partnership Agreement. The agreement was developed through a process of contact with existing committees and NSW Agriculture representatives and a series of meetings with representatives of the stakeholders. The completed Agreement was forwarded to the Hunter Catchment Management Trust and relevant Local Councils on 10 May 1999 for adoption by 30 June 1999.

Major Points of Agreement

- The Agreement sets the framework for future regional management between the following Councils within the Hunter and Central Coast. Great Lakes, Gloucester, Dungog, Port Stephens, Newcastle, Maitland, Cessnock, Lake Macquarie, Wyong and Gosford.

- Under the Agreement each member Council remains the Local Control Authority, retaining the functions to control noxious weeds within its area under the Noxious Weeds Act 1993.

- The Hunter Catchment Management Trust will fulfil the role of financial manager and will house and provide support services to the coordinator.

Benefits Derived from Adopting the Partnership Agreement

- Provide a framework that will allow the introduction of new strategies such as resources sharing.

- Appointment of Hunter Catchment Management Trust as manager with the potential to have a permanent regional coordinator.

- Improved Regional Planning resulting in coordinated and complimentary weed management plans. This includes extension, promotion, mapping and control.

- Continued funding through the Noxious Weeds Grant Application process.

- The ability to seek funding from other sources such as Dune Care, Catchment Trust, Heritage Trust etc.

- Increased cooperation from member Councils with a more professional approach to weed management.

- Establishment of a centralised information resource centre for weed management within the Hunter and Central Coast region.

Additional Coordinator Activities During Project Period

- Assisted the Lower Hunter and Central Coast Committee develop six Regional Weed Control Plans for funding in 1999-2000. Early indications are that five of the six plans submitted will receive funding.

- Provided secretarial functions at and for all Committee meetings.

- Organised a computer based mapping program demonstration.

Take Home Message

It is possible for general purpose Councils to achieve regional coordination and cooperation in weed control without the need to resort to County Councils provided a suitable Partnership Agreement can be developed, adopted and adhered to.

EMPLOYMENT OF A COORDINATOR

Regional Weed Action Program (RWAP)

Noxious Weeds Committee – Sydney North

Joanne Lynch
Bushland Technical Officer
Ku-ring-gai Municipal Council, Sydney

BACKGROUND

The Noxious Weeds Committee – Sydney North (NWC-SN) consists of representatives from all local councils, relevant State Government agencies and catchment management committees from the Sydney northern suburbs area which are responsible for the management of noxious weeds. The committee formed in January 1996 and meets once every three months.

The committee has developed a Regional Weed Strategy which was adopted in May 1998. The main objective of the strategy is to provide a framework for the coordinated, regional approach to weed management in the Sydney North Region.

The NWC-SN was successful in obtaining a Regional Weed Action Program grant for the 1998/99 and 1999/2000 financial years to employ a coordinator for the committee.

The coordinator commenced work in October 1998 and works, on average, 14 hours per week part time.

AIMS & ACHIEVEMENTS

The aims of the coordinator are to:

- administer and co-ordinate the NWC-SN;
- implement the actions of the Regional Weed Strategy in consultation and co-operation with the NWC–SN;
- establish and assist the development of working groups as outlined in the strategy;
- coordinate NWC-SN activities for Weed Buster Week;
- coordinate the updating and development of the strategy and educational brochures for the NWC-SN;
- financial responsibilities for membership fees and miscellaneous financial transactions; and publicise regional and local weed control policies, strategies, legislation, actions and

events.

Achievements of the coordinator so far:

- The formation of and assistance to the following working groups:
  - * Research;
  - * Legislation;
  - * Community Education, Awareness & Involvement;
  - * Planning & Management; and
  - * Resource Allocation.
- Organised Weed Buster Week and media releases for newspapers and radio.
- General administrative support – produced agendas and minutes for meetings and supporting documents,
  distributed strategy.
- Organised Ministerial launch of the Regional Weeds Strategy and the Noxious Weeds Brochure "Stop the Spread" at Lane Cove National Park on 7 December 1998, including the coordination of invitations, weed displays, media releases and a guest appearance by Woody Weed!
- Coordinated the production of three Regional Weed Control Plans, two of which were recently approved –
  one for Pampas Grass and one for Ludwigea.
- Currently updating the noxious weed brochure "Stop the Spread" for its second print run.
- Currently coordinating the organisation of a regional weeds conference for October 1999.
- The financial responsibilities have not been possible as the committee is not yet incorporated – however the committee aims to achieve this within the next 12 months.

CONCLUSION

The RWAP grant received by the NWC-SN has been very successful so far. All representatives of the committee are extremely busy people. The employment of a coordinator 2 days per week has been a huge boost to the committee, not only allowing it to achieve much more than it would otherwise, but also increasing the motivation and commitment of individual representatives. In addition, it will ensure the successful implementation of the regional strategy and an increase in important activities such as public awareness and education campaigns.

PAMPAS GRASS MANAGEMENT

A Regional Weed Action Program in South West Sydney

Luke McLachlan
Noxious Weed Officer
The Council of Camden

INTRODUCTION

Pampas Grass (*Cortaderia spp)* is a large tussock native to South America, with four species indigenous to New Zealand. Before the mid Eighties, when it was declared noxious, Pampas grass had been a popular ornamental garden feature. Since declaration as a noxious weed, many plants had evaded detection and flourished in suburban gardens. Each flower head has the potential to produce 100 000 wind dispersed seeds, posing a serious threat to native bushland. Preferring moist, open sites with sandy soils, disturbed areas such as fire trails and paddocks are particularly susceptible to infestation.

THE PROGRAM

Five councils applied under the Regional Weed Action Program (R.W.A.P.) for funds to assist in the eradication of Pampas grass from Southwest Sydney. We received $27 950 for the program, which was distributed as follows:

Bankstown City Council - $2 200
Camden Council - $2 750
Fairfield City Council - $1 000
Liverpool City Council - $1 000
Sutherland Shire Council - $21 000

All grants were matched, except for that to Sutherland Shire Council, which was required to contribute $5 000.

Stage one

The first stage of the program involved surveying of respective local government areas in Autumn, when the plant is in flower and most prominent.

Stage two

A publicity campaign was undertaken to unearth plants hidden in suburban backyards. This was achieved through prominent advertisements in the local press, posters and publicly distributed flyers.

Stage three

Presence letters were forwarded to all properties where Pampas grass was found to occur. Plants found to be growing on public land were removed immediately to help foster compliance amongst landowners.

Stage four

Follow-up inspections on all affected properties were carried out, and Section 18 notices were served where necessary. Further inspections were performed to ensure control work was completed.

Control of Pampas grass

Removal of flower heads is an excellent first control method. This is best done in late summer before the seeds mature. Effective control of small plants is achieved through grubbing. This is more difficult with larger plants, so, where possible, machinery is used. In other situations, Glyphosate (1.3*l* / 100*l* water plus surfactant) provides practical control of Pampas grass.

RESULTS

As would be expected, all control work on public land was completed quickly and effectively. Sutherland Shire Council was a resounding success in this area, spending $26 300 on control work and producing a massive decline of this weed species in the Sutherland Shire. Twenty-four presence letters were issued for infestations on private property.

Liverpool City Council, with few known areas of Pampas grass infestation, concentrated on raising community awareness in its rural region through newspaper advertisements and community talks. Feedback was then added to their ongoing mapping program.

Fairfield City Council also concentrated solely on publicity campaigns. This resulted in the discovery of plants in five locations.

The Council of Camden was successful in locating 43 new infestations of Pampas grass. All of these were located through inspections – advertisements in the local press resulted in no information in relation to the weed.

Bankstown City Council also achieved good results through surveying and control work. Approximately 90 plants were identified.

Overall, response from all forms of publicity used during this program was disappointing.

TAKE HOME MESSAGES

We can not be certain as to how effective each publicity campaign was, due to lack of response from the community. Although advertisements asked residents to contact their local council if they found Pampas grass on their property, it is possible plants were eradicated without informing the local control authority. Alternatively, we may have been informed of all plants in the region. Unfortunately, the most likely scenario is that Pampas grass still exists in suburban backyards in Southwest Sydney, and will continue to disperse seeds throughout the region. Locating these may only be possible through door to door inspections of the suburbs. Therefore, the most cost-effective method of locating Pampas grass would appear to be through old-fashioned hard work – you can't sit back and expect it to come to you.

ACKNOWLEDGEMENTS

Eddie Ferry, Noxious Weeds Officer, Fairfield City Council
Geoff Doret, Noxious Weeds Officer, Sutherland Shire Council
Brendan Galway, Noxious Weeds Officer, Liverpool City Council
Rob Corby, Bushland Officer, Bankstown City Council
Gary Warton, Chief Weed Officer, The Council of Camden

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REGIONAL WEED CONTROL PROGRAM

STATE MAPPING PROJECT

Bruce Scott
General Manager/Chief Weeds Officer
Far North Coast County Council

OVERVIEW

The State Mapping Project involves Local Control Authorities from around the State. The aim of the project was to evaluate weed management software and GIS systems for weed monitoring.

A late paper will be presented to Conference Delegates as the project was not finalised by the date papers had to be submitted.

OUTCOMES TO DATE

Very few of the systems were installed without a lot of drama. A lot have lessons have been learnt and this information will be included in the formal report.

The two main software packages investigated were CivicView and WeedMap. To get the greatest benefits from either program they need to be linked to a GIS system with tagged cadastral digital maps.

Where Local Control Authorities already have GIS systems in place the system can work well. The main hurdle in these situations is making sure the Council property files are in a format that can be utilised by the software.

Where County Councils are involved the problem is not so easy. The required cadastral map with tags are expensive. The maps required for the Far North Coast County Council would cost just over $100,000, money the County does not have.

The second problem is getting the data from constituent Councils in a form that can be readily uploaded to the system. This exercise took the Far North Coast County Council over four months to achieve.

NSW Agriculture has indicated that it would like to see uniform Section 18 Notices, Reports etc. This can be achieved by any of the software packages however the templates supplied with WeedMap, which were checked by NSW Agriculture, were not suitable in many respects. Civic view is more versatile in that any forms and reports can be readily modified. This could mean Councils would gradually adapt them to their needs, reducing uniformity.

CivicView requires the GIS interface. Where Councils have that facility the system appears to meet all needs. For County Councils, WeedMap without the GIS system may be more suitable.

The project has certainly been interesting and has highlighted a number of problems with the systems trialed.

The final document should be interesting reading.

TAKE HOME MESSAGE

Do a lot of homework before purchasing any weed management software. Ensure that it will meet your need within your budget. When one thinks computer system, think ongoing expenditure.

NOXIOUS WEEDS OFFICERS ASSOCIATION NSW
PRESIDENTS REPORT 1998/99

Bryson Rees
District Weeds Officer
Wellington Council

The second term of the current executive is drawing to a close and I believe ground has been made in some areas and a few home truths have been presented also. Training, rates of pay, communication between Officers, Association member numbers and recently Weed Control Plans have all crossed our path in recent times.

Meetings with local Government and Shires Association and representatives of the Municipal Employees Union proved fruitful but a very clear point was put to us and has been repeated on several occasions. Due to Council sizes, budgets and work priorities there will never be an equal playing field on rates of pay for Officers. It comes down to the offer of each Council and the negotiating skills of Weeds Officers individually, ie Bogan Council does not have the population, rates income or budget to match that of Coffs Harbour and this is a classic reason why we are all paid various rates of pay throughout the state. The Municipal Employees Union has pointed this out to us very clearly and without the support of the Union we basically will go nowhere.

Training, co-ordination of courses, national competencies have taken a lot of the time especially the last twelve months while time consuming, there will be benefits and a career path of learning for Weeds Officers of the future. Our past studies and skills will be recognised under the national competencies. The input of Weeds Officers into the competencies and training has been forthcoming and must continue if we are to receive the finished product that will benefit and be user friendly to all levels in the weeds industry.

The Macquarie Valley Weeds Advisory Committee has appointed Mr Reg Kidd as Project Officer/Consultant for their $120,000 education and training package for Weeds Officers. His contact numbers are 01582614 or 0263614562 or Fax 0263617065 and he would appreciate any thoughts or information that will be a benefit. The Weeds Officers' Association fully supports this project.

Communication from officers to executives is still a problem, while a little improvement has been seen from a few areas of the state. There is still room to open the lines up even further as we need to know if we are to continue to push for a further progress. Membership numbers have had an increase but the number of newsletters mailed out is more than member numbers. Progress has been made in "Co-ordinated Training Courses", meetings of understanding with the Union and Local Government and Shires Association. Maybe it's time for Weeds Officers of the industry to decide upon the direction they wish the Association to head in now, but to get a fair representation across the board we need an increased number of members to give us that final direction.

The travel award has been a subject we have been tossing around for some time but unable to come up with a final decision (America has fallen through). It would be good to be able to finalise a travel award at our meeting and maybe do a membership drive during the remainder of the conference with a draw to take place involving Association members only on completion of the conference. Your ideas are required now!! Bring them to the meeting Tuesday night.

Finally I will be putting myself forward for re-election at the meeting and at the time of writing this report other members of the executive had not spoken to in relation to standing again. I would like to thank Roger Smith and Kevin Nelligan for their support during the past two years. Our Regional Representatives, Publicity Officer and any other member that has crossed our path thanks to one and all. One looks forward to a constructive AGM and a good attendance.

TAKE HOME MESSAGE:

Weeds Officers are asked to become members if they are not already, communicate more and this will help all in making a stronger Association, working for a better future and high standards.

Bryson Rees
PRESIDENT.

THE STATUS OF BIOLOGICAL CONTROL OF *LANTANA CAMARA* IN AUSTRALIA

M.D. DAY[1] & R. H. HOLTKAMP[2]

[1] Alan Fletcher Research Station, PO Box 36, Sherwood, Qld, 4075
[2] NSW Agriculture Weed Biological Control Unit, RMB 944, Calala Lane, Tamworth, NSW, 2340

ABSTRACT

The status of biological control of *Lantana camara* in Australia was reviewed. Although biological control of lantana began in 1914, the plant is still a serious problem and further research is warranted. Seventeen agents out of the 28 introductions have established however, only four are causing substantial damage. The major factors influencing the successful establishment of the agents appear to be the large number of lantana phenotypes that are present and the wide range of climates in which the plant can grow. Some agents have shown a preference for only one or two lantana phenotypes, while only two agents are found throughout the climatic range of the weed.

Renewed efforts are being made to achieve better biological control of the weed. Two agents are being released in Queensland and NSW and two additional agents are being tested for their host specificity. Field exploration to locate new agents is being conducted in Mexico and Brazil. By assessing agents and releasing them on suitable lantana phenotypes and into suitable climatic areas, establishment rates should improve, resulting in better biological control of lantana.

INTRODUCTION

Lantana camara originated in tropical America and was cultivated in Europe prior to its introduction to Australia and many other countries in the mid 1800s. It is now a serious weed of coastal and subcoastal eastern Australia, affecting national parks, forestry areas and grazing lands, reducing biodiversity and productivity (Swarbrick *et al.* 1995). Through hybridisation, there are now over 650 phenotypes worldwide (Stirton 1977) with 29 occurring in Australia, of which some are toxic to cattle (Smith & Smith 1982).

Biological control of *L. camara* began in 1914 and 28 agents have now been introduced. However, only 17 species have established and just four are causing substantial damage (Julien & Griffiths 1998). The large number of lantana phenotypes present and the diverse climatic range in which the plant can grow, are the main factors which have been proposed as influencing the successful establishment of agents on lantana (Neser & Cilliers 1989).

Experimental studies at the Alan Fletcher Research Station (AFRS) and observations in the field have shown that some agents display a preference for some lantana phenotypes over others. Haseler (1966) noted that the pyralid moth, *Salbia haemorrhoidalis* showed a strong preference for red lantana while the noctuid moth, *Neogalea sunia* showed a marked preference for white and pink lantana. Harley (1973) reported that the tingid *Teleonemia scrupulosa* has failed to develop populations sufficient to damage common pink lantana. The moth *Ectaga garcia* and the mirid *Falconia intermedia* do not perform as well on common pink lantana as on other phenotypes (Day *et al.* 1999; M.D. Day & T.D. McAndrew unpubl. data).

The distribution of agents on lantana throughout eastern Australia has been strongly influenced by climate. Only two agents, the flower feeding moth *Lantanophaga pusillidactylus* and the seed feeding fly *Ophiomyia lantanae,* occur in all areas where lantana is a problem, although populations are very small towards the southern part of their distribution. Some agents, such as the hispine beetle *Uroplata fulvopustulata* and the tingid *Leptobyrsa decora,* have very limited distributions, being confined to the northern tropics around Cairns and the Atherton Tableland. In addition, the cerambycid *Plagiohammus spinipennis* has only been reported to have established in central NSW, while the tingid *Teleonemia harleyi* is reported only around Gatton in south-east Queensland.

This paper reports on the status of biological control of lantana in Australia, highlighting the damaging agents, agents currently being released and those presently under study.

AGENTS CAUSING SUBSTANTIAL DAMAGE

The two agents causing the most obvious damage to lantana are the hispine beetles, *Uroplata girardi* and *Octotoma scabripennis*. Larvae of both these agents mine leaves of all lantana phenotypes, suppressing plant growth and causing a reduction in flowering. *U. girardi* prefers open sunny areas from Sydney to Cairns, while *O. scabripennis* prefers cooler shady areas from Sydney to Rockhampton. Both species tend to be more abundant during warm summer months when lantana growth is greatest, while populations tend to be suppressed in the cool, dry winter months when lantana often dies back or loses its leaves.

Another agent which can be very damaging is *T. scrupulosa*. Adults and nymphs suck the sap from leaves and can cause plants to become stressed and stop flowering. *T. scrupulosa* tends to prefer drier regions and populations can be suppressed if humidity becomes too high. *T. scrupulosa* is found from Sydney to Cairns and has been reported on all phenotypes, but it appears to show a preference for red and white lantana over common pink. However, recently the insect is showing good control of pink lantana in some open dry regions of central Queensland with plants being stunted, defoliated and having reduced flowering.

The fourth agent which is damaging is *O. lantanae*. Adult *O. lantanae* feed on flowers, while the larvae feed on developing fruits and seeds. Recent preliminary studies at the experimental lantana plot at AFRS show that up to 80% of seeds can be damaged by this fly during the summer months, however, its overall effect has still not been properly quantified. Seed-feeding birds such as silvereyes tend not to feed on drupes damaged by the fly so seed dispersal is suppressed. *O. lantanae* is found from Sydney to Cape York on all phenotypes and is most common in the summer months when lantana is most in flower.

Several other agents are widespread but their impact on lantana is limited. The flower feeding moths *Epinotia lantana* and *L. pusillidactylus* feed on all lantana phenotypes in the field and are quite common during the summer months when the plant is in flower. The leaf feeding moths *Hypena strigata* and *N. sunia* are also seasonally abundant but are generally confined to coastal regions or where lantana growth is more healthy.

AGENTS CURRENTLY BEING RELEASED

The stem sucking membracid *Aconophora compressa* was first released in 1996 around Gatton and has established. *A. compressa* prefers red and white lantana over common pink. However, small colonising populations are present on the latter phenotype in some parts of NSW. *A. compressa* appears to be affected by high temperatures and so releases are currently being conducted in NSW and higher altitude areas of Queensland.

A. compressa has the potential to be very damaging, as branches and stems die back if populations become high. One of its limitations is that females care for nymphs before they lay new batches of eggs. Therefore, intrinsic growth rates are low and populations may take several years to build up to significant levels.

The leaf feeding beetle *Alagoasa parana* was first introduced by CSIRO and was released in low numbers in 1981. Unfortunately, the work was terminated due to lack of funds. Initial establishment occurred at one site at Mt Glorious in south-east Queensland, however, this site was later damaged by fire and no adults have since been recovered (D.P.A. Sands pers. comm.).

A. parana has since been re-imported by AFRS and small releases have been made in northern NSW. *A. parana* has the potential to do well, as adults diapause during the dry winter months when plant quality is generally poor. The adults are fecund when they exit diapause in November which coincides with the time of rapid plant growth where foliage is of high quality. *A. parana* prefers warm wet areas and experimental laboratory trials show that it does better on red lantana rather than common pink.

AGENTS CURRENTLY UNDER STUDY

The mirid, *F. intermedia* originates from Jamaica. Adults and nymphs suck the sap from leaves, stunting the plant and reducing flowering. Adults are very fecund and the life cycle is only about three weeks, so consequently populations can build up very quickly. Current host specificity tests show that it attacks only *L. camara* and another introduced weed *Lippia alba*. Approval for its release should be sought in late 1999.

The lantana rust *Prospodium tuberculatum* originates from Brazil and is currently being studied at AFRS, in collaboration with the International Institute of Biological Control (IIBC) in the United Kingdom (A. Tomley, pers. comm.). *P. tuberculatum* is proving very damaging to plants in the laboratory, especially common pink lantana. This is seen as highly significant to the control of lantana as many agents have not performed well on this phenotype. The rust has not attacked any other plant species and its release should be sought later in 1999.

AGENTS UNDER CONSIDERATION

AFRS has also contracted entomologists in Mexico and Brazil to locate and study insects that may prove useful in controlling *L. camara*. Two cerambycids, *Parevander xanthomelas* from Mexico and *Aerenica multipunctata* from Brazil, are being studied with the view to importing them into quarantine. A stem galling fly *Eutreta xanthochaeta* and a budmite *Aceria lantanae* are being

studied at the Plant Protection Research Institute, Republic of South Africa and a decision to import will be made pending the results of these studies.

TAKE HOME MESSAGE

Through the renewed efforts by AFRS and with assistance from the NSW Lantana Taskforce, research into biological control of lantana is continuing. New initiatives have resulted in greater collaboration both within Australia and overseas, giving rise to several agents being imported and others targeted for further investigation. Recent studies have suggested that potential agents should be tested for their preference to particular lantana phenotypes and that rearing and release strategies should be conducted accordingly. Agents should also be released into areas to which they are most climatically suited. Through the adoption of these initiatives, the prospects for better biological control of lantana are promising.

ACKNOWLEDGMENTS

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DUPONT MACSPRED TRAVEL AWARD REPORT

Kevin Nelligan
Noxious Weeds Officer
Cowra Shire Council

First and foremost I would like to take this opportunity to thank Dupont Australia and Macspred for their continuing support for this award and commitment to the Noxious Weed Industry whilst providing this opportunity for Noxious Plant Officers to travel and see at first hand problems in other areas and how other States and organisations handle emerging weed problems.

Secondly it is with sad regret that I make mention of the passing of John Abbot, Advisor, Dupont Australia. He was a strong supporter for the Noxious Weed Industry, The Travel Award and Noxious Weed Officers in general. He will be sadly missed at this conference for his shananikins at and around the bar. If there was a ruckus or commotion anywhere and at any hours John was usually involved, as his mischievous smile always gave him away anyway.

I would like to declare a minutes silence in memory of John Abbott, Noxious Weed supporter extraordinaire (omit if already done).

AIM:-

To gain further training and experience in the biological control of St. Johns Wort.

DESTINATION:-

Keith Turnbull Institute, Frankston, Victoria

The Institute is located on 70 hectares of land in Frankston, 37km south-east of Melbourne. Facilities include a main administration building with library, a conference centre, a world class biological control quarantine facility, a mass-rearing insectary, an insectary glasshouse, insect rearing building and permanent insect-rearing field cages, plant propagation facilities including a potting area, four glasshouses and six large polyhouses, herbicide application/herbicide technology facilities and laboratory, a toxicology laboratory, animal laboratory and extensive field compounds for vertebrae pests, along with a workshop and equipment storage areas.

My arrival in Frankston was greeted with a nice sunny afternoon on a lazy Sunday in November.

My host was Franz Mahr, Research Officer at the Institute. Franz is in charge of monitoring biological control of St. Johns Wort and Blackberry.

A tour of the Institute was arranged for day 1.

The Quarantine building was an experience to remember, after entering via a security card, we came into a chamber and had to don white suit, cap and a cumbersome pair of overshoe slippers. Upon entering the next room I felt rather cumbersome, in such attire and was afraid of what I might resemble.

However, the room housed many various paraphernalia for containment of plants complete with various insects, beetles, pathogens etc.

Morning tea was a time to meet other staff members and to enquire as to what other programmes were underway at the Institute.

There is a Trivia time at morning tea with much rivalry as to who has all the answers.

A visit to Arthur's seat on the second day revealed a picturesque area complete with restaurants and chair lift. Boneseed was the offending weed in this area. One of the problems Weed officers' face is that weeds are not all to discerning as to where they establish. We seemed to be for ever faced with obstacles like beautiful bush tracks and scenery and looking at areas that Tourists etc pay dearly for the privilege, therefore I am not complaining, would you?

The next day saw us somewhere in the Dandenong's, the Lilydale, Olinda area, looking at a newly found rust fungus on Blackberry, again an area to be envied.

Then we were off to Castlemaine and on route saw Serrated Tussock down to almost sea level. Don Baldwin you are not unique. A case not seen in NSW perhaps cool conditions in this area brings it within its range.

Somewhere in this vicinity a big old man grey came into my range though and took a swipe at my ute, however, not much damage occurred and when last seen he was looking in my direction with a rather puzzled expression.

The final leg of the journey was through Castlemaine and up to Beechworth, during this trip we were visiting various trial sites where Franz was occupied locating each plot within his trial. When found, a quad rangle was placed over each replication and each individual wort plant being identified within the quad, these plants each had a grid reference in cms so their conditions could be measured recorded and appraised and compared to previous years as to how the mites were performing from year to year. A miticide was used on the control.

Beechworth, a very historic gold mining town is set along a creek which I believe was diverted to facilitate gold working.

This beautiful area complete with a roaring waterfall right in town, hails a baker shop that emits aromas that bring in such custom that standing room is hard to find. There is also a winery just out of town called Penny Weight, with a host that complements each visitor with such an array of free samples that you leave both inebriated and with quite a larger collection of local wines. However, being a native of Cowra, it would be politically nieve of me to say too much about other wines.

Finally I must compliment Franz Mahr for his hospitality and for the time he spent taking me around and giving me an insight into this part of the Noxious Weeds Industry. Incidentally Franz if

you run out of weeds at Beechworth, just give us a call and I am sure we can find a way to accommodate you in this endeavour.

Conclusion

St Johns Wort

- Is a problem in VIC too.
- Is continuing to spread in both States.
- Has an extremely wide range.
- Can infest more country
- Is easily spread by travelling stock.
- Bio-agents are having some impact
- Needs further input re bio control
- Is one of the highest costing weeds in the State.
- Needs further injection of funds both Local and State.
- A lift in on farm income is needed to sustain chemical/control, pasture improvement eg: wool
- Has some benefits
- Can be harvested

Take Home Message:

All you young and up coming Weeds Officers get you arse into gear and write a paper for future Dupont/Macspread Travel Awards.

ACKNOWLEDGMENT

John Abbot and Matt Jones (Dupont), Bernie and Shirley Horsefield (Macspread), Geoff Keech (Macspread), The Keith Turnbull Institute and Franz Mahr (K.T.I.)

GROUNDSEL BUSH RUST, *Puccinia evadens* Hark., A NEW BIOCONTROL AGENT FOR GROUNDSEL BUSH, *Baccharis halimifolia* L.

A. J. Tomley
Department of Natural Resources
Alan Fletcher Research Station
PO Box 36, Sherwood, Q 4075

Introduction

The rust, *Puccinia evadens* is a native of Southern USA and is a naturally occurring parasite of groundsel bush, *Baccharis halimifolia*. Detailed host specificity testing was carried out under contract to the Department of Natural Resources, Alan Fletcher Research Station by a team headed by Professor Ragavan Charudattan at the University of Florida. Importation and field release of the rust was approved by the Australian Quarantine and Inspection Service in March 1997. A single shipment was imported into the AFRS quarantine in June 1997, reared through one generation to ensure that it was free from parasites and diseases and released into the greenhouse for bulking up and field release. Field release was commenced in south-east Queensland (SEQ) in October 1997.

Reproductive biology

Puccinia evadens is a long cycled rust with all five spore stages occurring on *B. halimifolia* concurrently or in different seasons. The rust is present throughout the year in Florida and SEQ. In SEQ all spore forms are found throughout the year. However, pycnia and aecia are more common throughout spring and summer, uredinia throughout autumn and winter and telia in spring. In Florida the rust is most abundant during autumn winter and spring and of lower abundance during the summer months. In SEQ rust incidence appears to be more even with high levels of aecia over summer and uredinia over the cooler months.

Disease symptoms and appearance of the various spore forms

- Pycnia are formed on both the leaves and stems causing swelling of the infected tissue. On the leaf they are present as small pin head sized black dots surrounded by chlorotic swollen tissue. They are often found together with aecia.

- Aecia are also formed on the leaves and stems, causing thickened elongate swellings and malformations on the mid-ribs of the leaves and cigar-shaped swellings on the latter. They bear bright yellow powdery aeciospores.

- Uredinia are set into the lower leaf surface appearing as small circular bright yellow to orange spots containing powdery urediniospores. They do not cause deformation of the leaf tissue but are frequently surrounded by a patch of chlorotic tissue.

- Telia appear as scattered orange-brown to dark brown pustules up to 1 mm diameter on the lower leaf surface and stem.

- Basidiospores are produced on the germinating teliospores and are characterised by the presence of a greyish bloom on the telia.

Host damage.

Field and greenhouse observations in Florida and field observations in SEQ show that pycnia and aecia cause more damage to plants that uredinia and telia. Heavy infection of leaves causes premature leaf drop while infection and deformation of stems results in stem dieback. In SEQ at the longest established site dieback of the stems to ground level followed by death of a small number of plants (ca 1.5 m tall) has been observed 18 months after initial infection.

Heavy infection of leaves by uredinia causes premature leaf drop.

In Florida, greenhouse trials have shown that high levels of infection resulted in stunting defoliation and death of seedlings.

Climatic requirements

The rust is spread by wind. Optimum conditions for spore germination and subsequent infection of the leaf or stem are a temperature of 20°C and leaf wetness (a film of water on the leaf surface) of 12 hours duration. In the field leaf wetness can be maintained by rain or dew formation. The rust will continue to cycle at a lower rate with sub-optimal conditions.

Practical methods of field inoculation

Various methods of inoculating plants in the field have been trialed.

Good results have been obtained by setting out infected potted plants in the field at a release site. Infected plants are removed from their pots on site and planted into the ground, after which they are maintained by natural soil moisture or hand watered as necessary. This method has the advantage of providing the widest window of opportunity for obtaining suitable conditions for infection. Fresh spores are continually produced by the starter plants over a number of weeks.

Field collection and redeployment of infected stems and foliage is also possible. However, in this instance the inoculation should be timed so as to ensure that adequate leaf wetness will soon follow.

Application of spore suspensions in water is the main method used for bulking up the rust in the greenhouse at AFRS and is also used for field release. Spores are vacuumed from infected plants kept in the greenhouse with especially designed collectors, dried and stored in liquid nitrogen to maintain viability. Inoculation of plants involves mixing the spores with distilled water to give a spore suspension which is sprayed onto the foliage. Spore concentrations of 1,500,000 spores per ml. are used. Spray apparatus ranges from a small air-brush, plastic trigger sprayer to a petrol powered misting machine. Again with this method, timing of application to ensure subsequent adequate leaf wetness is essential.

Take Home Message

Trial releases indicate that groundsel bush rust appears to be a worthwhile addition to the suite of insect agents already established. Successful control of the weed however, is most likely to be achieved by adopting an integrated approach.

ACKNOWLEDGMENTS

The author is grateful for the assistance received from Natasha Riding and Tom Anderson.

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