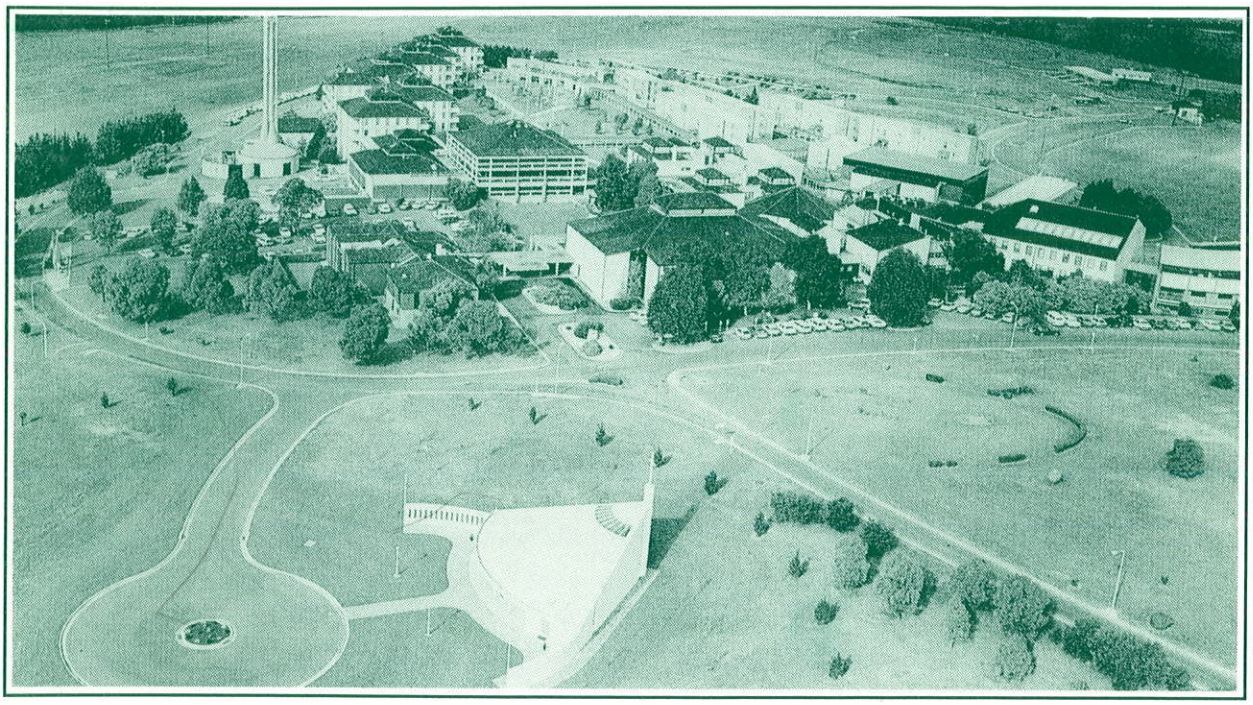
8th BIENNIAL NOXIOUS WEEDS CONFERENCE

"Better Planning for Better Weed Management"



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Volume 1

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Peter Gorham
Conference Convener
NSW Agriculture
Cowra

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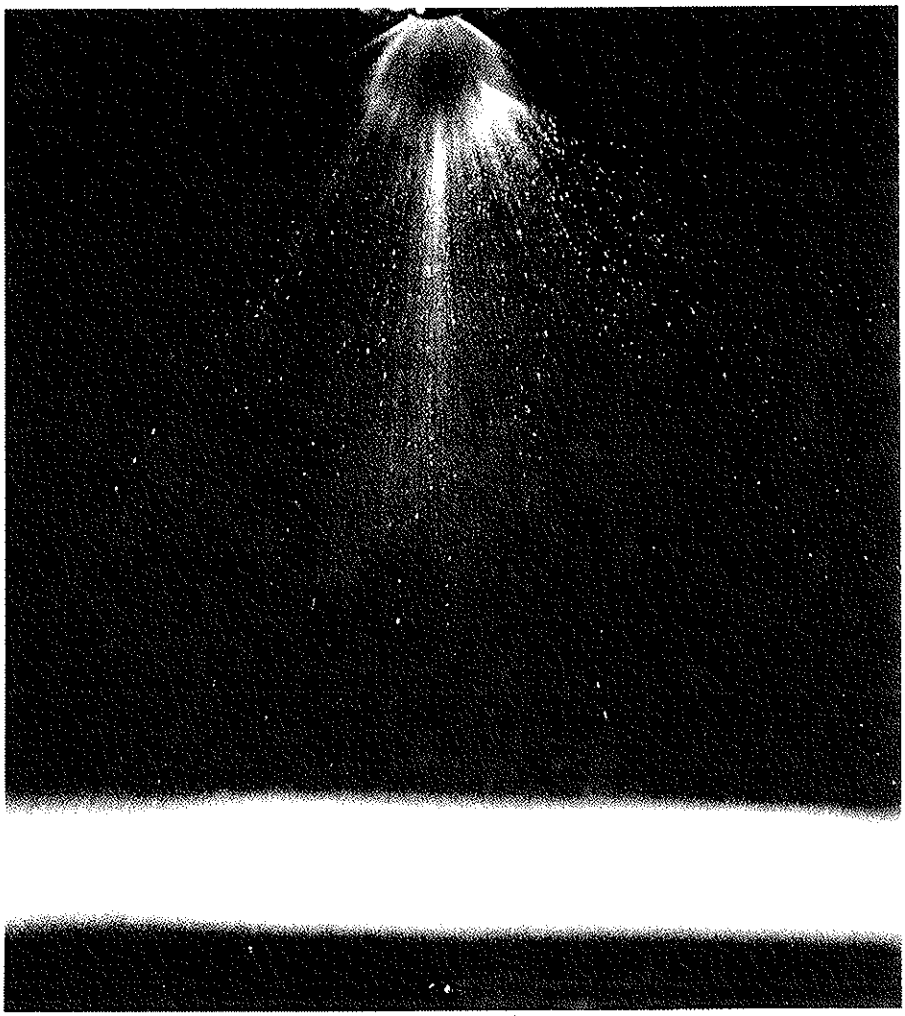

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CONTENTS

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CONTENTS - CONTINUED

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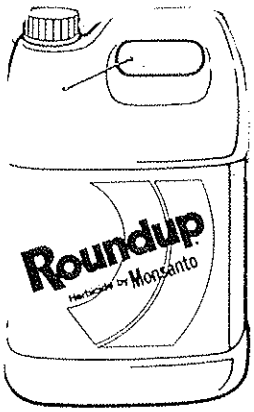

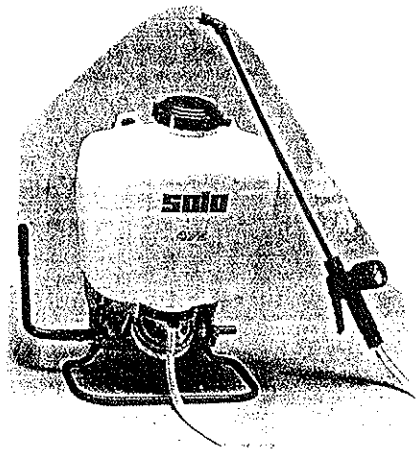

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PROGRAM

8th Biennial Noxious Weeds Conference

Tuesday, 19th September
Wednesday, 20th September
Thursday, 21st September

NSW Police Academy
GOULBURN

1995

8th BIENNIAL NOXIOUS WEEDS CONFERENCE

Program

DAY 1 - TUESDAY, 19th SEPTEMBER 1995

CHAIRMAN - VAL STUBBS, MID-WESTERN COUNTY COUNCIL

8.30 Housekeeping ..... *Peter Gorham*
8.40 Welcome to the Academy ..... *Reg Mahoney, Chief Superintendant*
8.50 Welcome to Goulburn City ..... *Mayor of Goulburn*
9.00 Opening Address ..... *John Wearne, President Shires Association of NSW*
9.15 Strategic Approach to Noxious Weed Control ..... *Doug Hocking, NSW Agriculture*
9.35 Keynote Address: "Weed Management Towards 2000" .....
..... *Dr Bruce Wilson, Qld Dept of Lands*

10.00 **Morning tea**

CHAIRMAN - IAN KELLY, CASTLEREAGH-MACQUARIE COUNTY COUNCIL

10.30 National Weeds Strategy: From Words to Action ..... *Ian Smith, Agriculture Vic*
11.00 Noxious Weeds Strategy for NSW ..... *Bob Paton, Consultant*
11.20 A Strategic Approach to Planned Management -
Serrated Tussock Action Plan ..... *Bob Sproule, NSW Agriculture*
11.45 Bitou Bush Control in the Shoalhaven with Community Involvement .....
..... *Ian Borrowdale, Shoalhaven City Council*
12.00 Managing Vegetation in an Urban Environment Based on Catchments .....
..... *Dr Jocelyn Powell, Hawkesbury Nepean Catchment Management Trust*

12.30 **Lunch**

CHAIRMAN - BOB LEECH, CROOKWELL SHIRE COUNCIL

1.30 Setting Priorities in Industrial Weed Management ..... *Jim Longworth, State Rail*
1.50 An Enhanced Weed Management Program for NSW National Parks .....
..... *Dr Andrew Leys, National Parks & WildlifeService*
2.10 Cycle Planning for Effective Woody Weed Control ..... *David Theriault, DowElanco Aust*
2.30 Promoting Yourself Through Planning ..... *Ken Fishpool, NSW Agriculture*

3.00 **Afternoon Tea**

DAY 1 - TUESDAY, 19th SEPTEMBER 1995 continued

CHAIRMAN - RON FRANCIS, BLUE MOUNTAINS CITY COUNCIL

3.30 Mapping Weeds Accurately Using GPS ..... *Peter Terrett, Global Star*
4.00 Long Term Planning Success in Containing Mimosa Pigra ..... *Ian Miller, Northern Territory Department of Primary Industry & Fisheries*
4.20 Computerised Inspection & Mapping Program ..... *Scott Clark, Rapid Map Australia*

EVENING SESSION

7.00 Elected Members' Meeting .....
Noxious Weeds Officers' Association Meeting .....

DAY 2 - WEDNESDAY, 20th SEPTEMBER 1995

CHAIRMAN - KIM BELLAIRS, FAR NORTH COAST COUNTY COUNCIL

8.30 Biological Control of Weeds in NSW ..... *Paul Sullivan, NSW Agriculture*
8.40 Mapping Weeds for Biological Control Programs ..... *Alan Maguire, NSW Agriculture*
8.50 Role of Council Weeds Officers in Biological Control Programs ..... *Paul Sullivan, NSW Agriculture*
9.00 Licenses for Herbicide Use in or Near Water ..... *Dr Jane Mallen-Cooper, EPA*
9.20 Saving Wetlands from Weed Invasion ..... *Geoff Sainty, Sainty & Associates*
9.40 Groundsel Bush Management Plan ..... *Jeff Thomas, National Parks & Wildlife Service*

10.00 Morning tea

CHAIRMAN - ROB DONOHOE, GRAFTON CITY COUNCIL

10.30 Streambank Weeds ..... *Geoff Sainty, Sainty & Associates*
10.45 Alligator WeedMIA Campaign - Has it Been a Success? .... *Hugh Milvain, NSW Agriculture*
11.05 Parthenium Weed Alert ..... *Peter Gray, NSW Agriculture*

11.40 Lunch

12.30 FIELD TOUR - CSIRO CANBERRA

Tour of facilities - Update on current and planned weed biological control programs - Scientists and Technicians from the Division of Entomology.

Division of Plant Industry biological control programs, Dr Richard Groves. Also from the Division of Plant Industry, Phil Larkin and Danny Llewellyn will talk about genetic engineering in plants.

6.30 EVENING MEAL - HELLENIC CLUB, WODEN

DAY 3 - THURSDAY, 21st SEPTEMBER 1995

CHAIRMAN - PETER GRAY, NSW AGRICULTURE

8.30 Legal section - the Noxious Weeds Act 1993 - Is it working? - Changes? Problems? Penalty Notices? Answers to Questions Put by Leas and Other Groups in Response to Survey - Declaration of W4 Weeds in Urban Areas - Property Inspection Procedure *Sally Pearmain, NSW Agriculture*
. . . . . *Lesley Skinner, NSW Agriculture*

10.00 **Morning tea**

CHAIRMAN - IAN TYE, MACLEAN SHIRE COUNCIL

10.30 Herbicide Resistance - Which Herbicide Group? . . . . . *Jim Dellow, NSW Agriculture*
10.50 Managing Silverleaf Nightshade . . . . . *Barney Milne, NSW Agriculture*
11.10 Dupont Product Update . . . . . *John Abbott, DuPont Aust*
11.25 Proper Management of Empty Farm Chemical Containers . . . . . *Doug McGuffog, Avcare*
11.50 Analysying Weedicide & Pesticide Residues for Compliance to Occupational Guidelines . . . . . *Robert Geyer, Workcover Authority*
12.10 The Advantages of Using Retractable Reels . . . . . *Grant Mitchell, Quick Spray*

12.30 **Lunch**

CHAIRMAN - KEN HAYES, COFFS HARBOUR CITY COUNCIL

1.30 Adjuvants - Future Trends . . . . . *Alex McLelland, AB McLennan Management Services*
1.50 Prickly Pear - A New Noxious Weed . . . . . *Les Tanner, NSW Agriculture*
2.05 Water hyacinth in the Hawksbury-Nepean River System . . . . . *Geoff Keech, Macspred*
2.25 Product Update . . . . . *Keith Fallow, Monsanto Aust*
2.40 Dry Product Technology & Envirodrums . . . . . *Nufarm Ltd*

3.00 **Afternoon tea**

CHAIRMAN - GRAHAM MATTHEWS, BELLINGEN SHIRE COUNCIL

3.30 What is Stress? . . . . . *Jan Westerink, Aust. Graduate School of Police Management*
4.00 Potential Invaders- Weed Alert . . . . . .
Weeds Awareness Week 1996 . . . . . *Bob Trounce, NSW Agriculture*
4.30 Closing Address . . . . . *John Fisher, NSW Agriculture*

7.00 CONFERENCE DINNER

STRATEGIC APPROACH TO NOXIOUS WEED CONTROL

D.F. HOCKING
Chairman Noxious Weeds Advisory Committee
NSW Agriculture

The most recent estimate of cost in weed control and lost agricultural production in NSW is $600M. annually to the environment is difficult to estimate, however it is substantial. All sections of the community are affected by weeds, both in their cost of control and the various consequences of lost production & environmental damage if they do invade their land. Weeds do not respect property boundaries and state borders. Propagation material is easily moved by natural means or assisted by man. Many of the modifications man has made to the environment in fact, makes it much easier for weeds to spread and invade certain areas.

If weeds continue to spread at their current rate, the impact, both financially and on the environment, will continue to escalate. Those involved in weed management, now and in the past, have recognised this and there are many examples of successful suppression and eradication programs. An example of this in New South Wales is the continued exclusion of parthenium weed. However, the battle is being lost against many weeds and unfortunately these outnumber the success stories. Some of these weeds include giant Parramatta grass and alligator weed.

If the community of New South Wales and Australia is to improve its performance in managing weeds, a co-ordinated, targeted, and realistic program must be developed. The first step in improving our weed management performance is to fully understand the magnitude of the task and then develop strategies to achieve the desired results.

I believe it is one of the key responsibilities of the Noxious Weeds Advisory Committee, to give a clear focus to what all the groups involved in noxious weed management should be attempting to do. This really means, what is possible in noxious weed management, what can we deliver on in terms of available, resources which weeds are really damaging our environment and causing production losses, and which weeds just don't look nice on the side of the road.

To achieve this, the previous Government approved the development of a Noxious Weeds Strategy for New South Wales. I would like to think that the strategy will set out to those in the weed management, the necessary guidance to develop effective strategies that are achievable, in keeping with the resources available, and if more resources are required, that these be assessed.

-ooOoo-

WEED MANAGEMENT TOWARDS 2000

Dr Bruce J Wilson
Manager, Development
Qld Department of Lands

Abstract. Future weed management must be based on the following key principles: planning, preventative weed management, sustainable land use, conservation of biological diversity, local ownership of issues, holistic approach, readily available information, objectively-based decision making, community awareness and maximising resources.

Planning provides the means for integrating the above principles with the requirements of higher order plans, legislation, policies and accountability, and achieving implementation. Plans fit into a hierarchy and should be consistent - Australia-wide, State-wide, regional (catchment, local government) and property-based. Queensland is implementing Local Government pest management plans, and property-based species plans as a means of complying with weed control notices.

Planning is supported with an information system under development (Pestinfo), Ministerially approved policies, pest status assessments (reviews to identify control objectives, policy and information gaps), awareness and eradication of potential pests, urban community awareness of weeds and strategic control services.

-ooOoo-

THE NATIONAL WEEDS STRATEGY: FROM WORDS TO ACTION

Ian Smith
Senior Industry Officer (Field Crops)
Agriculture Victoria

Introduction

*Millions of gossamer - slung trifid seeds, free now to drift wherever the winds of the world should take them.**

The decision to define a *National Weeds Strategy (NWS)* was made in July 1991 by the then Standing Committee on Agriculture. It was one further initiative in a policy progression towards greater definition of environmental issues.

The Decade of Landcare Plan announced by the Commonwealth in 1991 was a timely reminder about stewardship to a nation which had unhesitatingly drawn on natural resources in pursuit of agricultural and industrial development. *The National Strategy for Ecologically Sustainable Development* released in 1992, made the case for a balance between development and respect for the ecological processes which underpin society. In June 1993 Australia ratified the International Convention on Biodiversity and instigated a *National Strategy for the Conservation of Australia's Biodiversity.* The problem of pest animals was addressed by the Vertebrate Pest Strategy in 1993. A re-examination of weeds issues in the context of environmental awareness was obviously appropriate.

By July 1995 the principles which underpin the NWS had been endorsed by the appropriate Standing Committees - Agriculture and Resource Management, Forestry and Conservation, a marathon of creative and administrative logistics.

The protracted development reflects the complexities in defining the gaps in "the big picture" and where to build on existing Commonwealth, State and Territories legislation to a balance of environmental and land use interests.

This paper emphasises the content of the report, its influence to date and progress towards implementation of a Strategy.

The Structure of the National Weeds Strategy

The report was presented as two papers. The first, *A Strategic Approach to Weed Problems of National Significance* is an overview of the issues and a statement of current principles of weed management. It is this document which has been endorsed by the Standing Committees.

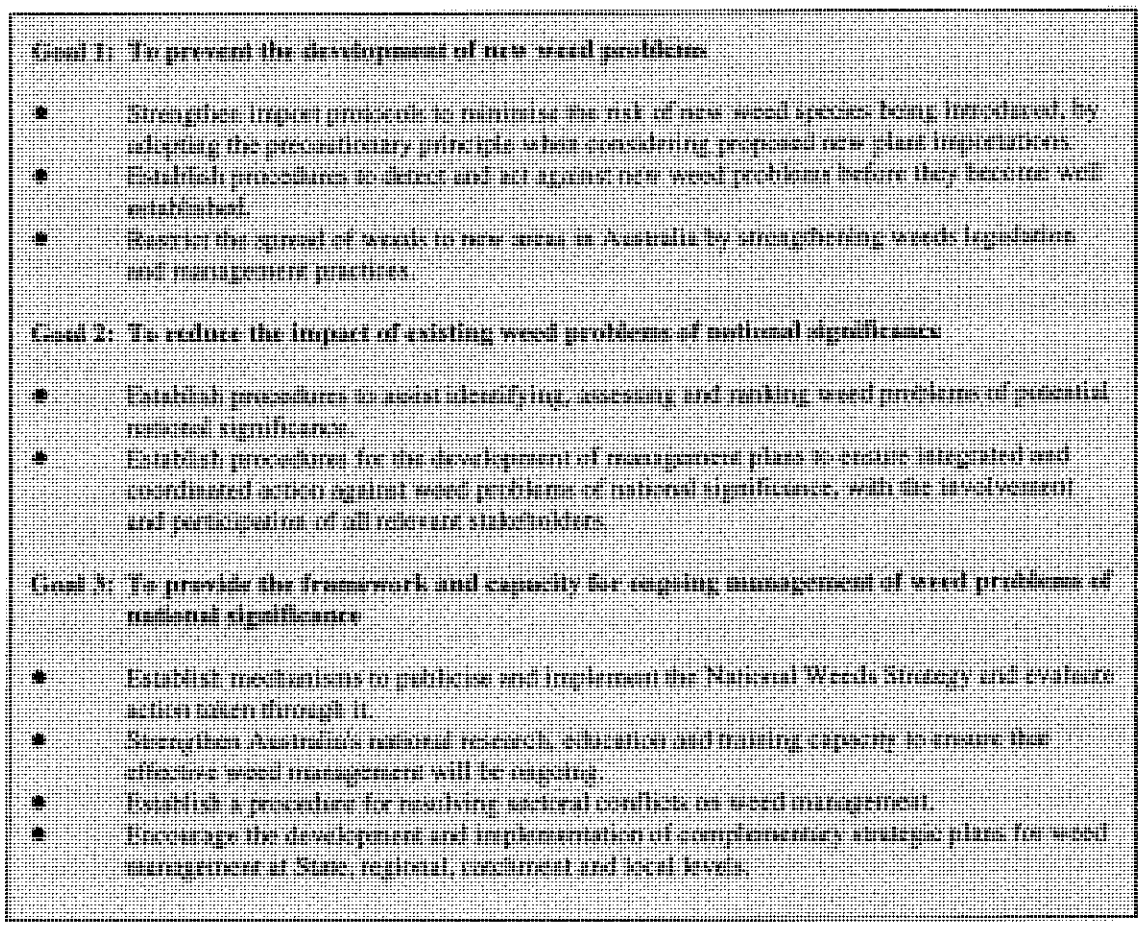
The second paper *Draft Recommendations for Initial Actions* grounds the principles document in specifics. This so-called Action Statement has been used to frame budget bids. It will always be subject to amendment on the basis of errors of detail and outdated budgets.

The Action Statement is not an endorsed document. It is almost a de facto adjunct to the recognised principles paper, but with one compelling strength - it contains all of the recommendations for a strategy! Policy-makers may ultimately amend the recommendations and ignore others, but to ignore them all means the demise of a national strategy.

The Content of the National Weeds Strategy

*And so the one in our garden continued its growth peacefully, as did thousands like it in neglected spots all over the world.**

The purpose of the NWS is to reduce the detrimental impact of weeds and thereby contribute to the sustainability of Australia's agricultural production and natural ecosystems. The strategy recognises the need to consider the influence of weeds in their entirety so that aquatic weeds, weed threats to near pristine environments, forests and remnant bushland receive adequate attention. It justifies the need for additional action in a review of current weed problems and explains why existing measures have been inadequate. The scope of the NWS is set by three goals and key strategies to deliver them (see box).



The detail of these strategies is obviously best left to a study of the full document, but the intent is crystallised in the specific recommendations which are discussed below.

For reasons of clarity, each recommendation has been paraphrased in this paper to delete the references to the Standing Committees and their subcommittees which are given responsibilities for the carriage of some recommendations. Also deleted are the cost estimates initially supplied for specific weed initiatives which may now be misleading. Suffice to say that the request for additional Commonwealth funding for weed initiatives presented in the paper in October 1994 totalled $10m, to be made available over three years.

Recommendations

1. Develop an improved quarantine screening system for assessment of the weed potential of all proposed new plant imports

The development of a more comprehensive assessment process to accommodate screening for potential weeds of natural ecosystems was presented at a workshop in Adelaide in June 1994. Further work on the proposed scoring system was coordinated by Paul Pheloung of the Agriculture Protection Board of Western Australia. A recommendation to seek adoption of the Weed Risk Assessment (WRA) system is now with Australian Weeds Committee. The WRA classifies each candidate for admission on an accept, evaluate or reject basis.

2. Develop a code of practice for plant scientists and plant breeding organisations to define obligations related to the testing and release of plant species that may have significant weed potential

This goes beyond the customary precautions required of agencies when evaluating new species in pasture nurseries. The "evaluate" option of the proposed WRA system of species categorisation includes the possibility of a temporary clearance for import for post-entry evaluation. The process as envisaged at the Workshop in 1994 would essentially expand the stringency of quarantine testing into more habitats for at least three, possibly five years, after which a final decision based on observations would be made. The Australian Weeds Committee is developing a draft code of practice for this option.

3. Review the report *"Operation of a Standing Committee on Agriculture and Resource Management Consultative Committee on Exotic Insect Pests, Weeds and Plant Diseases"* and report on changes needed to ensure that the quarantine contingency action process is equally appropriate for action against new and existing weeds of agriculture, forestry, bushland, conservation areas and aquatic systems and provides appropriate cross-sector representation in the formulation of action plans.

The report is essentially a statement of the process which was activated to achieve eradication of Kochia *(Kochia scoparia)* in Western Australia in 1991 and Siam Weed *(Chromolaena odorata)* in Queensland in 1994. Both programs demonstrate a commitment to the second goal of the NWS in early action for eradication of species which evade or "slip-through" quarantine screenings. There remains however the need to use the report as a template for a formal statement of process within NWS.

4. Monitor and review progress on the development and implementation of State legislation relating to weeds and report on action needed to achieve consistency with the principles established in the National Weeds Strategy

The arguments for uniformity of States and Territory weed legislation or a congruency of legislation (in which seemingly different approaches to weed management across state borders achieve the same outcome) continue at Australian Weeds Committee. A consensus on approach will not be easily achieved.

5. **Develop guidelines for the determination of the relative national significance of weed issues and the procedures for assessing their priority for a National Weed Strategy**

At issue is the need for an objective reporting format which minimises intuitive `leaps' because of a paucity of information. The format must be comprehensive and challenging to elicit answers to many dimensions of the issue. Such a process may require weighting of data in order to evaluate and prioritise examples of weed problems of northern Australia compared to those of southern Australia. The assessment used in the NWS paper was a `first-cut' at the required format.

6. **Provide additional resource to manage urgent weed issues of national importance which commence with:**

- Containment and eradication of Mimosa at its western outreach on the Daly River/Port Keats Land trust,
- The establishment and maintenance of a Rubber Vine Buffer Zone on the Queensland/Northern Territory border; and
- The eradication of outlying infestations of Prickly Acacia and controls strategically important infestations of the northern Mitchell grasslands.

A budget for these initiatives prepared by the Department of Primary Industries and Energy for 1995-96 was rejected by Cabinet.

7. **Current action for control of Athel Pine in central Australia and Bitou Bush/Boneseed in Queensland, New South Wales and Victoria is adequate but must be maintained to ensure adequate control.**

8. **Many species warrant further evaluation, some of which include Blue Thunbergia, Parkinsonia, Mesquite, Mission Grass, Bellyache Bush, Parthenium Weed, Noogoora Burr, Serrated Tussock, Alligator Weed, Rice Grass, Water Hyacinth, Salvinia, Gorse, Bridal Creeper and hybrid willows.**

Recommendations 7 and 8 are invitations to researchers and community groups to submit applications for additional action against specific weeds within the NWS framework.

9. **Current programs to achieve a faster rate of adoption of Integrated Weed Management in agricultural production systems must be maintained.**

Because of the potential for immediate financial benefits which derive from weed management research and its application in agricultural production on the most arable land, this sector was assessed as `self-sufficient' and not an immediate priority for specific additional action.

10. **That consideration be given to the provision of Commonwealth seed funding, (to be matched by industry), and administered by the Forest and Wood Products Research & Development Corporation, for research on Integrated Weed Management to reduce herbicide use in plantation forestry and minimise off-target movement of herbicides.**

No Commonwealth funding was provided for this purpose in 1995-96.

11. **That comprehensive management or recovery plans effectively addressing threats from weeds be prepared and/or periodically reviewed by relevant agencies in respect of all important conservation areas, endangered ecological communities and nationally significant ecosystems such as: Kakadu National Park, Arnhem Land, Lakes Woods and Silvester on the Barkly Tableland, the Gallery Forests of the Gulf of Carpentaria, the tropical Melaleuca swamps, designated areas of the Mitchell grasslands and all Australian sites listed under the Convention on Wetlands of International Importance (the Ramsar Convention).**

Information to the writing team was that such plans were at various stages of preparation.

12. **That consideration be given to:**

- **Providing funds to community Landcare, catchment management and similar groups for weed control activities with a long term control or eradication focus and which generate community rather than private benefit; and**

- **further funding of community based "urban" bushland conservation/regeneration projects which have a focus on longer term weed control or eradication.**

As far as I am aware no additional funding has been provided for weeds issues through the Landcare budget or in any other form.

13. **Establish a national coordinating body to report directly to SCARM, SCC and SCF on implementation of the National Weeds Strategy to report directly to the relevant standing committee(s) on implementation of the National Weeds Strategy**

Membership of the national coordinating body will be drawn from the three Standing Committees: Agriculture & Resource Management, Conservation & Forestry. The current view is that the Coordinating Committee may then delegate much of the responsibility for action and progress reporting on a particular weed species to the most appropriate Standing Committee(s).

14. **Revise membership, terms of reference and reporting relationships of the Australian Weeds Committee**

Australian Weeds Committee is the technical resource group which will assist the proposed coordinating committee but the current composition and expertise within AWC may not be appropriate, or is not perceived to be appropriate, for the responsibilities which may ensue in the management of a "big-picture" strategy.

At present 2 members in a total of 18 directly represent conservation (Australia and New Zealand Environment & Conservation Council) interests.

15. **That the position of Coordinator: National Weeds Strategy be established within an appropriate Commonwealth agency for an initial term of three years to facilitate linkages needed to implement the National Weeds Strategy**

Here is a key indicator of the actual regard of policy makers for the NWS. Without a full-time coordinator there will still be opportunities for new and worthy initiatives but there will be no greater sense of a strategic national vision than exists now.

Where To From Here?

*We think now that we can see the way, but there is still a lot of work and research to be done until we have wiped the last one of them from the face of the land that they have usurped.**

Even if chapter and verse of the NWS was never implemented I contend that the spur to thinking and the number of skilled people drawn into aspects of the process and now influenced by it, have already incrementally upgraded both action and planning on weed issues.

Consider:

- The Australian Quarantine & Inspection Service has implemented a scoring system to appraise applications to import new plant species which is based on a prototype of the WRA assessment. A further upgrade would be a small step.

- The spotlight is on the process of testing and evaluation of potential pasture species which in some locations are likely to be aggressive invaders of natural ecosystems.

- The writing of the NWS has in part inspired action to develop weed strategies for Tasmania (in draft), Northern Territory (in draft), NSW (Search Conference held) and SA (proposal).

But to talk of the NWS falling at the last hurdles is negative thinking. More relevant is the fact that a second round of consultations with major stakeholders represented by their peak industry bodies is imminent. Presentations will be made to National Farmers Federation, Australian Conservation Foundation, National Landcare Advisory Committee, National Association of Forest Industries and the Australian Local Government Association.
Presumably some modifications to the text may be required, but once this is clarified the package of measures can confidently be submitted to the Agriculture and Resource Management Council of Australia and New Zealand and the Agricultural and New Zealand Environment and Conservation Council where upon NWS, in a large or small way should be reality.

* Extracts from *The Day of the Triffids* by John Wyndham. Penguin Books.

-ooOoo-

PROGRESS TOWARDS A NSW NOXIOUS WEED STRATEGY

Mr Bob Paton
Consultant
NSW Department of Agriculture

Weeds are certainly not a new problem in Australia, probably gardeners on the first fleet complained about native grasses and woody weeds that invaded their vegetable plots. However, the magnitude and characteristics of the problem has changed, driven largely by introduced plant that have become weeds and which now significantly reduce our crop production and threaten native ecosystems. In many cases like the introduced plant Serrated tussock the problems are often beyond the capacity or resources of land managers to control or contain them.

On the positive side increasing community awareness of land degradation problems, over the past few years, has resulted in a greater appreciation within governments and the community of weed problems from which has developed initiatives like the National Weed Strategy and local programs of weed control undertaken by community volunteer and Landcare groups. However, are we doing the right things and are programs as effective as resources permit? Not always easy questions to answer, made more difficult because of the widely varying views people have on what are the real problems and how best to tackle them with the resources that are available.

While the National Weeds Strategy may provide a framework to combat damaging weeds that effect Australia each State needs to consider its own noxious weed policies and strategies, which while complementing the national strategy, also provides the mechanism for dealing with its own weed priorities. How then do we proceed to reach an agreed approach for weed control in New South Wales?

The Search Conference (Goulburn, 4-6 August 1995) made a substantial step in this direction bringing together, as it did, a wide cross section of people with widely varying backgrounds and perspectives on weed problems. Through the skills of the facilitors Bob Sproule and Tim Burfitt and the enthusiastic interaction of participants, the framework of an agreed approach for noxious weed control is now much clearer.

In this presentation, to summarise some outcomes of the Conference and to stimulate discussion, we are going to consider a couple of the statements that appear in Session 7 of the Draft Report on Proceedings of the NSW Noxious Weed Conference, since they are beginning to near what might be an agreed approach for combatting noxious weeds in NSW and from which an achievable strategy could emerge.

-ooOoo-

A STRATEGIC APPROACH TO PLANNED MANAGEMENT - SERRATED TUSSOCK ACTION PLAN

Bob Sproule
NSW Agriculture
Goulburn

INTRODUCTION

It is interesting to see the development of any *'plan'* that has been presented to the stakeholders as a *'fait accompli'*. In this day and age such a plan has a very difficult path to gain acceptance as there is a natural reaction to look mainly at the negatives in it. Such a plan may founder on an issue that, in the overall view of things, could be regarded as relatively unimportant.

There is now an expectation in the community of involvement through consultation that leads to ownership of the planning process. This is one of the strengths of the Landcare movement.

With this in mind, the Serrated Tussock Action Plan was developed very much from the bottom up. What follows is an outline of methodology of the planning process. It is not held up as an *'ideal'* but rather as an example of how we tried to achieve general acceptance and ownership when we looked at developing a coordinated action plan for tussock control.

THE CONSULTATION PROCESS

Who are the stakeholders? When you ask this question you may find a very formidable list of groups such as Landholders, Councils, Landcare, NSW Farmers, Government Departments, CSIRO, utilities such as Sydney Water etc., environmental groups, chemical companies, contractors, government and consultants. All these people may have an interest or be affected in any plan that is likely to be developed and will need a forum to voice their opinions.

It is not easy to satisfy the people who feel they have a stake in the plan if you don't consult them. The problem is how to achieve this consultation within a satisfactory time frame and without it becoming an endless process of to-ing and fro-ing from one group to another.

What we want to do is develop a shared perspective of the problem, solutions and actions. If we achieve this shared perspective we will achieve ownership of the outcome.

For the Serrated Tussock Action Plan we used a technique called a Search Conference which was held at Berridale in August 1994.

In a Search Conference there are no speakers as in a more conventional conference. The people who are participating are selected because of their position in their organisation, their knowledge of the subject and/or they have an interest in the outcome (e.g., environmental groups).

Briefly, a search conference goes through a series of steps where a common perspective is developed about what is happening in the real world, the collective history of the subject, in this case serrated tussock, the current system of control, its

strengths and weaknesses, a vision of an ideal system, the constraints to achieving that ideal and an action plan to overcome the constraints and put new policies and strategies in place.

Some of the achievements already from the Search Conference include the establishment of a Working Party which meets monthly; the investigation of the feasibility of bio-control; the bringing of weeds into the Landcare funding sphere; a survey of tussock infested areas to complement surveys in 1975 and 1985 and addressing weaknesses in the legislation.

SHARING KNOWLEDGE

While the Search Conference achieved a shared perspective and some initiatives it was felt that the stakeholders should be updated on what was happening in tussock and tussock control. So the Serrated Tussock Working Party organised a follow-up seminar at Goulburn for Councils and other interested parties. The seminar dealt with the results of the survey of tussock, biology and control, planning, the role of Weeds Officers and Councils. Participants as a group looked at what factors make tussock difficult to control? What are the limitations of Councils? What are limitations of the legislation? and Who are the other Players in Serrated Tussock control?

The Seminar included an address by Brian Scarsbrick, Chief Executive, Landcare Australia on the topic *The Role of Landcare.* It is important to recognise that the Landcare movement has become a potent force in the community and we should consider their contribution in any program that might be considered.

At the Goulburn Seminar it was agreed that we should hold a series of planning meetings to:

1) Develop a combined action program on a district basis, between Councils, Farmers, Agribusiness and Government Departments to control serrated tussock.

2) Ensure we have a consistent approach in regard to policy and inspection.

3) Look at areas of work where support can be given by other workers and organisations.

4) Develop greater public awareness as to the problem of noxious weeds and serrated tussock in particular.

PLANNING

The planning meetings which followed the Goulburn Seminar were held at Bathurst, Goulburn and Cooma. An effort was made to involve as many stakeholders as possible. Broadly, four plans were produced, three district and one generic (applies equally over the three district plans).

It was agreed that we should address the following issues within the plan:

a) **Education/Awareness** - This entails recognition of the problem and what needs to be done. This is particularly important in the tablelands where we

have a large number of absentee landowners and rural residential type properties.

b) **Efficiency** - If we are to make an impact there is a need to improve the efficiency of our inspection service. An example of this is the use of a helicopter and GIS system for inspections to pinpoint infestations. (There is nothing in the Act to say you must walk over the property.)

c) **Facilitation** - How can we improve the control methods and make things easier for landholders? Such activities as contract spraying provide a service for landholders who do not have spray equipment or have other difficulties in carrying out the work. Aerial spray programs are cost effective and ensure large areas can be handled expeditiously at the right time. Labour programs such as LEAP and NWO are two examples where councils can get paid labour to clean-up roadsides etc.

   If the efficiency of inspection is increased by such methods as using a helicopter and GIS then more time is available for the control program.

d) **Coordination** - Liaison with neighbouring shires not only reduces the work load through joint spraying programs but if adjacent areas are handled in two shires the impact on control will be increased and costs will be reduced where aerial spraying is conducted.

e) **Think Big** - With a weed like Serrated Tussock (740,000 ha + on the tablelands and Monaro) we need to look at removing large areas if we are to make headway in controlling it.

f) **Consistent Policy** - This is required both within and between Councils and relates to inspection, facilitation, notices, prosecution and general attitude to the problem of weeds.

PUBLISH THE PLAN

No plan is worthwhile unless all the stakeholders have a copy and for that matter anyone else interested in what is going on. It should not be a secret document.

USING THE PLAN

Don't put it away and forget it, otherwise you have wasted your time.

Use a planning calendar and note the events and activities you are committed for and the timing and time span they will take. When you have done this you may see even further opportunities to refine and develop your plan.

COORDINATION OF THE PLAN

Requires someone to liaise with those involved to assist and see that those activities planned are progressed.

There is a saying that *"Not only must it be done, it should be seen to be done"*. Publicise your activities and achievements, they also provide encouragement to those labouring to control their weed problem.

BITOU BUSH CONTROL IN THE SHOALHAVEN WITH COMMUNITY INVOLVEMENT

IAN BORROWDALE
Chief Weeds Officer
Shoalhaven City Council

We as Managers of various weeds and vegetation control programs have available to us what I believe to be a relatively untapped resource. I am referring to the community in which we live and work.

I first became aware of the dangers that Bitou Bush posses to our natural environment after attending the National Bitou Bush and Boneseed Conference held in Port Macquarie in 1984.

At this Conference we learned how Bitou Bush has the potential to infest the majority of the East Coast of Australia and during a tour of the Port Macquarie area saw graphic evidence of how Bitou Bush can quickly dominate native species and become the dominant plant.

Upon returning to the Shoalhaven area I implemented a relatively minor control program using Council labour and Council funds to control Bitou Bush in what I considered to be key locations of the City. At the same time had discussions with several Progress Associations in an attempt to heighten the awareness of the community to the dangers of Bitou Bush and to encourage community involvement in the follow up work which consisted mainly of hand weeding to prevent the Bitou Bush from becoming re-established.

I consider these programs to be of only moderate success because the Council funds were limited as was the enthusiasm of the community groups involved.

In the late 80's and early 90's there developed a community awareness of the need to protect our environment, that has been recognised by all levels of Government and by the community in general.

Over recent years there has been a proliferation of community groups, formed to address a particular need that is of concern to the community. These groups include Neighbourhood Watch, River Watch, Landcare, Dunecare, Parks and Reserve Management Committees, Present Committees and Progress Associations etc.

These groups mainly fall into two categories, the first such as Progress Associations, Present Committees etc identify issues which are then past on to the relevant authority for action or resolution and secondly groups such as Dunecare, Landcare etc which are actively involved in the project at hand and may only require minor assistance from Council's such as expert advice, supply of materials, equipment etc to achieve their goals.

Most Council's and other authorities usually respond favourably to projects put forward by these particular groups because as we well know the highest cost inmost projects, particularly, weed control these days is labour.

Over the years Shoalhaven City Council has supported and participated in various weed control projects with community groups. Our most recent success in this regard

is a program to control Bitou Bush in the Culburra area. For many years Council has shared my concern at the unchecked spread of Bitou Bush in the Shoalhaven and in particular in the Culburra area. Limited work was carried by Council in conjunction with community groups to control Bitou Bush on beach front Reserves. A helicopter inspection of all beach front areas within Shoalhaven identified Culburra as being our worst infested area and application was made in 1993 to have Bitou Bush declared a Noxious Weed. This was granted by the Noxious Plants Advisory Committee with the stipulation that grant funds were not to be expended on the control of Bitou Bush and that the declaration would reviewed after 3 years. Council's main reason for requesting the declaration was to be able enforce control on private land. To effect this in a manner acceptable to land owner and to the community in general a comprehensive public relations campaign was mounted by Council in the Culburra area to "sell" the need to control Bitou Bush to the owners of property and to the community in general.

To achieve this the following strategy and timetable was implemented:

1. Aerial inspection of area.
2. Inspections to assess the degree of infestation of Bitou Bush on private land in the Culburra area was carried out.
3. A report was presented to Council outlining the degree of infestation and the number of properties infested with Bitou Bush and the reasons why Bitou Bush should be controlled.
4. An awareness campaign was promoted through local media expanding on the Council Report.
5. A letter from Council was sent to every property owner (vacant and occupied) in the Culburra area who may be involved in the control program.
6. Community groups ie Progress/Present Committees and Dunecare groups operating in this area were informed of Council's actions.
7. Control that had been on going on beach front Reserves was intensified using Council's day labour.
8. Local Dunecare groups were supplied with spraying equipment, chemical and additional training and advise on how to control Bitou Bush and were actively involved in the control program. This included the co-ordination of the various groups actively involved in this area, the mapping and the keeping of records of areas treated to insure adequate follow up.
9. Advise and assistance was given to property owners responding to Council's letter requesting co-operation.
10. Section 18 Noxious Weed Notices were served on property owners who had not carried out satisfactory control work.

I feel that this program has been a success particularly in the way that it fully informed property owners and the community of Council's actions and actually brought about a desire within these groups to carry out control work. The degradation of the environment by an exotic weed was a major influencing factor and the community now has ownership of a program which was seen to be successful visibly measurable and morally desirable. Many persons associated with this program, including land owners have advised me of a sense of achievement that they have felt by carrying out this work and have also advised that they are committed to insuring that Bitou Bush does not become again established in this area.

I believe that whilst the program was time consuming on my part if the full cost of implementing and maintaining such a program using Council or contract labour were taken into account, the cost would be many times higher.

In these days of economic restraint the community expect and deserve public funds to be used to the best advantage. In this respect I believe we must work smarter rather than harder and use all the resources that are available within the community to achieve our objectives.

-ooOoo-

MANAGING VEGETATION IN AN URBAN ENVIRONMENT BASED ON CATCHMENTS

ABSTRACT

Ecologist W Royal Botanic Gardens

Dr Jocelyn Powell
Hawkesbury-Nepean
Catchment Management Trust

It is generally accepted that management of vegetation is important particularly in urban areas where human impacts are so dominant. Whether or not such management should be catchment-based is open to debate - plant species, communities and vegetation types all cross catchment boundaries, as do the managers!

Some of the main impacts associated with urban areas are: clearance and fragmentation of vegetation types; loss of natural habitats; loss of biological diversity; potential for increased soil erosion and movement of sediments; introduction of exotic plants and animals; increased nutrients and pollutants carried in run-off; water pollution of creeks and streams; increased bushfire risk; and direct impacts associated with the urban-bushland fringe and recreation, amongst others.

When it comes to considering management then numerous people are involved - individuals, community groups, landcare, bushcare, rivercare groups, catchment management committees, councils, county councils, State government agencies etc. While their actions can be complementary they are at time contradictory.

In this paper I will outline how a framework for vegetation management has been developed, the aspects considered most important within it and how it can best be implemented. I shall take as my "case study" the Hawkesbury-Nepean Catchment, a catchment under great pressure from urbanisation.

-ooOoo-

SETTING PRIORITIES IN INDUSTRIAL WEED MANAGEMENT

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Abstract

For most managers of large industrial land estates, controlling weed growth is just one of many competing objectives. Rarely are there sufficient resources to meet all demands. Priorities must be set, compromises reached. The paper critiques the dominant agricultural paradigm, which is found inappropriate. Other decision making models are presented, as possibly worth trialing.

Introduction

A weed is defined as "a plant growing out of place" (Whittet 1958). This definition applies equally to plants growing in cropping, grazing, forestry, horticultural, aquatic, and industrial situations. However the managerial context within which the weeds grow, varies greatly. The very definition of "a plant out of place", invites the question; "Says who?". Answers vary from the land manager, through various interested external stakeholders, to the legislators. Bazzaz (1984) recognised the inherent anthropomorphism of the term "weed", and suggested minimising use of the term in ecological literature. However decisions on controlling the colonising species, occur in the managerial, not scientific arena. Richardson (1989) called for a method to assess weed impact, based on; (1) Potential to invade; (2) Deleterious effects; (3) Economics of managing.

EMIC or ETIC Weeds

Personal value systems influence the decisions people take, including that of how important weed control is. Values specific to a particular culture are known as emic values, and those found in all cultures are known as etic values. Values held by managers of industrial land, will typically differ from those held by people from an agronomic or natural resources background.

On lands managed for their natural resource values, manager's have an inherent interest in maximising the value of, or return from the land. Values &/or returns are maximised by limiting threats to the core productivity. Weeds pose one such threat, so are controlled. However on many industrial estates, the land is not valued for its natural resources.

Rather, the land may be seen as a liability, that has been; inherited from previous managers; is ancillary to core business; is left over but is not worth disposing of; is below the allowable minimum area for subdivision; or merely provides the land area for the foot-print of infrastructure, necessary for the business to function. Under such circumstances, the species of vegetation growing on the land, may be irrelevant. St. Johns Wort or Kangaroo Grass, may be equally acceptable.

Industrial Land Units

Land used for industrial purposes occurs in the form of corridors, annuli, or free-form areas. Corridors include; footpaths; roads; railways; canals; pipelines; cable runs; transmission lines, etc. Annuli include areas around factories, offices, shopping

centres; etc. Free-form areas include; storage yards; transformer yards; car parks; pedestrian plazas; etc. Both corridors and annuli have high to extreme edge/area ratios. The high edge/area ratio, means that virtually the whole of the corridor or annuli is subject to influences originating on adjoining land, commonly referred to as the edge effect. On industrial land, the edges are sharp and abrupt, resulting from artificial disturbance, not natural ecotones that have resulted from a gradual blending of environmental factors. A narrow width (in absolute terms) of corridors, may mean that edges of adjacent sides merge or overlap, reducing the area of undisturbed land to zero (Buchanan 1979). Corridors for service industries may be further subdivided by internal infrastructure, eg; roads; railway tracks; access tracks; fire breaks; transmission lines; cable troughing; drains; etc. The result is a corridor made up of a series of more or less parallel bands of disturbed land and edges, with no or little core of undisturbed habitat.

An ideal environment for colonisation by opportunistic plant species. Seeds dispersed by adhesion, may be carried along within the corridor by road or rail vehicles, animals, or people. Other seeds may be attached to equipment by a sticky surface, or on ledges or in protected nooks. The elongate shape and tendency for dead-end peninsulas, means that dispersal rates for desirable populations to outlying parts of the land unit, may be very slow and probably unsuccessful (Diamond 1975).

Historic legacies of previous land management practices, and full exposure to invasion by weed propagules from adjoining lands, means that weeds are probably already established on the land. Therefore, preventing invasion is not an option for preventing colonisation. The remaining two options for controlling weeds are; (1) intervening once invasion has begun; and; (2) rehabilitating the invaded land (Panetta & Hopkins 1991). With inadequate resources, and realising that eradication is biologically impossible, weed control becomes just that, "control".

Controlling an existing and dynamic population means; setting priorities; allocating resources; supervising programs; etc, ie; making decisions. Importantly, decisions will all be dependant on what are the management objectives for the land (Scanlon 1989), or personal value systems of the managers.

Only after a managerial objective has been set, can the process of decision making function; (1) Set managerial objectives; (2) Search for alternative solutions; (3) Compare and evaluate alternatives; (4) Choose; (5) Implement the decision; (6) Follow up and control. Even then the economic value or very point of suppressing weeds in industrial situations such as roadsides has for many years been questioned (Moore 1971).

An Industrial Example

Criteria for controlling weed growth on a railway track, illustrates the many and varied criteria, on which the decision to control or not to control, may be made. About twenty different criteria are known from the literature. All, or any, in any combination, may apply to the same length of track, at any given time. Each value has different stakeholders. One could take the most limiting criteria for a given length of track, and aim at achieving that. This would ensure that all less demanding criteria were also met. However that may impose an excessively high standard of control. The stakeholder could well lack the power [1] **to resource or enforce their desired standard anyway. A more strategic approach is called for.**

Agronomic Models

Most models for managing weeds, have been developed in agricultural situations. Industrial weed control is not even recognised as such on product labels and usage recommendations, but is included under the aggregate term of "non-crop situations".

Typically agronomic models propose a; negative; linear or preferably curvi-linear; regression model, eg; Streibig et. al. (1989). Regression models are based on a biological association between weed biomass (on the independent X axis), and crop production (on the dependant Y axis). Based on empirical studies and competition theory for limiting resources, as weed biomass increases, crop production decreases, which is expressed in a rectangular hyperbolic curve. At the low end of weed density, the loss in yield may be below the limit of detection, rather than the assumption that there is no loss of yield (Cousens 1985).

The decision to control an agricultural weed, is based on determining the point where the cost of control, is exceeded by the loss of return on the value of the crop if the weed is not controlled. The threshold point at which control becomes a priority is determined statistically. However statistical significance does not necessarily have any theoretical, managerial, or practical significance. Nor is the threshold point likely to be visually identifiable.

The model's usefulness in predicting the threshold density, is only expressed in terms of the economic value of the crop. Chamala & Keith (1987) have identified the importance of the additional human and institutional (ie; the surrounding socio-cultural environment) factors. The value of industrial land is usually unrelated to any natural or crop value, the land being wholly valued by other criteria, or swamped by the value of the infrastructure on it.

Increasing weed growth on industrial land, does not necessarily produce corresponding infinite changes to the value of the land. In some cases, a single plant may totally degrade the value of a parcel of land, eg; a single Fennel plant in a bowling green. In other cases, masses of weed plants may not degrade the value of the land in quantifiable any way, eg; Blackberry plants growing over a factory rubbish tip.

On industrial land, the relationship between weed biomass and quality or value of the land, is likely to be a series of pass/fail bars. Any correlation coefficient (r), is likely to be close to zero. For many of the criteria, the weed biomass is either acceptable or not acceptable. The relationship is based on stakeholder perceptions, not necessarily a rationalist cause and effect relationship. Usually there are many criteria, and they are often independent to each other.

On industrial land the issue is of total plant biomass. On most sites this will comprise several species, each with individual control requirements. What is required is a total kill of all vegetable matter, not selective removal of some species while allowing other plants to grow. Agricultural models are not applicable for managing industrial lands, others need investigation.

Legislative Models

The NSW "Noxious Weeds Act" (1993) establishes the administrative framework for identification, classification, and control of noxious weeds in NSW. Within this Act, control categories are not differentiated on the basis of land use. Industrial land is

regarded as identical to land under any other use. Note however, that weeds on industrial land occupied by public authorities, need only be controlled "to the extent necessary to prevent the weeds from spreading to adjoining land." (S. 13.).

Controlling the invasiveness of a particular species appears fundamental to proclaiming a species as "noxious". While legislation can wield a big stick, proclamation also indicates the community's concerns and expectations. Unfortunately over use of the big stick may produce a negative image of the object (weed control), as well as a learned emotional reaction to the stimuli (fines or imprisonment).

Establishing an attitude towards weeds is fundamental to success in gaining control. But attitudes held by a manager, are dependant on more than just coercion and classic conditioning through fear (Gagne 1985). Changing manager's behaviour will require them acquiring; natural resource sensitivity; knowledge and a personal investment in the issue; and an internal locus of control (Hungerford & Volk 1990). Some potential exists here through environmental education, as has been demonstrated by the greening of many businesses.

Multi Criteria Optimising Models

Managers of industrial land are faced with a plethora of objectives. The land is often under valued or is seen as a liability. Weed control is seen as an additional cost, imposed by legislation, requested by adjoining land managers, or lobbied for by stakeholders. Control produces "nice" but unquantifiable benefits.

Many objectives are in competition with each other, some are contradictory, and most will be judged by different, but currently unidentified stakeholders using different sets of criteria. Perhaps the concept of optimising a single objective, the "uniquely optimal" solution is not appropriate for industrial land. Not all conflicting objectives can be maximised simultaneously. Increasing the success in meeting one objective, automatically reduces the likelihood of achieving some of the others. Resources are never adequate.

An alternative approach might be to replace the single objective, with a "best compromise" solution. Optimality is moved towards through an iterative process, though may never be reached. The problem becomes to optimise a set of conflicting objectives, subject to the same set of constraints.

Mathematical models are available for providing a solution which yields the best possible value for the multiple objectives, while staying within the limits of available resources. Known as multi criterion optimising models, they can be grouped into three approaches; (1) combining all objectives into a single one; (2) converting objectives into constraints, either sequentially or simultaneously; (3) developing a new objective other than the decision variables, and treating all objectives as constraints to be satisfied (Adulbhan 1978).

All three approaches use a number of interactive cycles (each with calculation and decision phases), with the decision maker relaxing satisfaction of some objective to allow an improvement in unsatisfactory ones in the next cycle. The objectives that can be relaxed and the amount of relaxation, must be describable. Unfortunately multi criterion optimising models, are strongly influenced by the strengths and weaknesses

of the different mathematical models that are available. Further study of their applicability to weed control is needed.

Environmental Impact Assessment Models

Environmental impact assessment models revolve around the formulae of; (1) Describing the existing environmental conditions of a site; (2) Superimposing a proposed activity onto the site; and; (3) Identifying the impacts likely to result from the interaction. Quantitative models for identifying and organising impacts in a systematic way, fall into classes of; checklists; matrices; networks; map overlays; or; brainstorming.

Once identified the impacts are evaluated by either aggregating public values into a single grand index, or disaggregating public values by distributing impacts among affected groups (Westman 1985). Traditionally EIA has been confined to single event development situations, however the process could be applied to maintenance situations.

Impacts can be significant or insignificant, in either qualitative or quantitative terms. Qualitative impacts may; invite attention; be noteworthy; important; outstanding; especially meaningful to society; etc. Quantitative impacts arise from the interaction's; size; degree; volume; area; etc.

Criteria are evaluated on criteria such as; beneficial or adverse; short or long term; avoidable or unavoidable; reversible or irreversible; direct or indirect; local or regional or global; cumulative or stand alone; etc.

Significant impacts are those that are likely to; degrade an important quality of the environment; curtail a beneficial use of the environment; advantage short term or special interest group interests to the disadvantage of long term or community environmental values; pollute the atmosphere, waters or land; or; are minor activities that have major cumulative effects.

Weed invasion certainly fits this model on a regional scale, or when considering new species, but its applicability for a discrete industrial site is suspect. Total catchment management, may offer philosophies to modify the EIA model so as to be appropriate for the case of managing weeds.

Hazard and Risk Models

Hazard and risk models have been developed to quantify the risk of incidents that are hazardous to people, our environment and property. Most models work through a series of steps, eg; (1) Define the quantified risks or safety targets, in terms of probability; (2) Identify and list the hazards of materials handled, processes used, and operations performed; (3) Assess the likely severity of the consequences for each listed potential hazardous incident; (4) Assess the probability or frequency of occurrence for each potential hazardous incident; (5) Assess the risk to the defined target, by multiplying the severity and frequency of each hazardous incident, then determine the total exposure for all incidents; (6) Determine the need to reduce risk by comparing the assessed cumulative risk against the determined targets; (7) Determine the most significant areas to reduce risk, by examining the factors that contributed most to the assessed risk (Tweeddale 1990).

While these models have been developed for life threatening incidents (discrete events), substituting invading plants for escaping chemicals or energy, would in theory be possible. However, further work is clearly needed.

Process Models

Decisions in controlling weeds are not routine. They are unique; intuitive; creative; adaptive; innovative; inspirational; complex; elusive; novel. Decisions are imprecisely programmed, and rarely re-occurring. Decisions are based on incomplete information and rely heavily on an individual manager's judgement. Rarely is there a recognisable structure. Information channels are often undefined, though there is usually a preferred outcome. However, the decisions have considerable consequences.

Decision making on weed control is both a product of and an influence on the organisational culture in which it occurs. Control decisions were traditionally made wholly within the land management organisation, eg; individual farm; Council parks section; Commission; Authority; etc. Priorities, goals, objectives, methods all could be determined by a small group of individuals arranged in a hierarchy within a single organisation. Not so now.

Now many disciplines and interested but unconstrained stakeholders, influence any weed control decision. The decision making process may be further complicated in that, budgets and therefore power, may be managed by professional managers rather than technical experts. The weed control officer, may be in an advisory or process position only.

Rationalist (or classical with a maximised outcome) models such as those based exclusively on agricultural or natural resource values, using maximised outcomes as their prime decision-making criterion, have several shortcomings. When applied to industrial land the shortcomings overpower the value of the model. Apart from the rationalist, decision making models include; organisational (or neoclassical, with a satisfying outcome); political (or adaptive, with an acceptable outcome); and; process (or managerial, with an objectives oriented outcome) (Harrison 1981).

While the organisational model does take note of external constraints, its short term perspective is typified by tactical adjustments to meet attainable objectives. Lacking is a long term planning orientation, to benefit the organisation and control of weeds. Because the political model aims at an outcome that is acceptable to many external stakeholders, its compromise or bargaining strategy, may disregard economic, biological, or technical aspects of the decision. Acceptance (possibly control) by external fringe stakeholders, may lead to not solving the original problem at all.

Compared to these three models, the process model is oriented towards long-term results, which will be achieved through a forward-looking, strategic planning process. Policies and procedures are not ends in themselves, but are viewed as guides to action, accommodating the innovative qualities so characteristic of weed control decisions.

CONCLUSION

Unlike agricultural models with a single criterion and operating within a uniform set of cultural values, industrial weed control may have many criteria and is often determined by those with totally non-agrarian values. Current agricultural decision making models

are inappropriate for weed control in industrial settings. Industrial weeds include many species that are not declared as "noxious", so legislative requirements are equally unhelpful. While standard texts (eg; Gangstad 1982) detail the methods and technology of control, they totally omit discussing the management framework within which decisions on control are made. Clearly new models for prioritising weed control programs on industrial land, are called for.

In the typical industrial situation, a process model would offer advantages of;

- Being strongly managerial in nature;
- Having objectives-oriented outcomes;
- Being interdisciplinary, drawing on; philosophy for values and ethics; economics and statistics for utility and probability; sociology and social psychology for group behaviour; law for anthropology, political science, environment; mathematics for models and simulation; psychology for individual behaviour;
- Being oriented towards long-term results;
- Having a planning mode;
- Looking towards the future and growth;
- Having a strategic orientation;
- Being able to accommodate changes in the way of doing business;
- Being eclectic;
- Emphasising quantitative values to reduce uncertainty in comparing and evaluating alternatives;
- Using bargaining to make proposals more agreeable to disagreeable constituents;
- Emphasising human, institutional, and environmental constraints.

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AN ENHANCED WEED MANAGEMENT PROGRAM FOR NSW NATIONAL PARKS

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NSW has an extensive system of national parks, nature reserves and recreation areas. The New South Wales National Parks and Wildlife Service is responsible for the management of these areas and for the protection and care of native flora and fauna throughout the State. Weeds are a major threat to the integrity of these areas, and weed infestations on Service lands may also pose a threat to neighbours.

Weed management on Service estate received a major boost last year with a substantial increase in funding for pest management (animal pests and weeds). The funds will be used to appoint and resource additional field staff in each District, enabling the Service to expand current weed control programs and to establish important new initiatives. During 1994/95 the Service has undertaken 146 weed control programs. Key programs include:

1. A cooperative program involving landholders, local community groups, key public authorities and universities to ensure an integrated approach to controlling bitou bush (*Chrysanthemoides monilifera*) on Service lands.

2. An ongoing program to control groundsel bush (*Baccharis halimifolia*) in the Yuraygir and Bundjalung National Parks is achieving excellent results and will be reported on in detail at the Conference by Jeff Thomas, Pest Management Officer at Grafton.

3. The Service has continued to fund the cooperative program for biological control of Scotch broom (*Cytisus scoparius*).

4. The NPWS is cooperating with NSW Agriculture and local government councils in a major campaign on serrated tussock (*Nassella trichotoma*). The Service also contributed towards a survey in Argentina of potential biological control agents for serrated tussock.

5. The NPWS is also working closely with volunteers to help regenerate bushland in Lane Cove, Garrigal, Kuringai Chase, Sydney Harbour and Botany Bay National Parks. Volunteers have worked with the service on a regular basis, helping to remove many weeds including bitou bush, lantana (*Lantana camara*), privet (*Ligustrum* spp.) balloon vine (*Cardiospermum grandiflorum*) and wandering jew (*Tradescantia* spp.).

6. The Service is developing a database to record and map the distribution of important weed species. Lismore District has already recorded information on the occurrence and distribution of all exotic plant species in rainforest remnants in Nature Reserves within its District.

The presentation will discuss these programs in detail and will highlight the weed potential of species such as Madeira vine (*Anredera cordifolia*), mist flower (*Adenophora ripara*), glory lily (*Gloriosa superba*), climbing asparagus (*Protasparagus africanus*), asparagus fern (*Protasparagus densiflorus*) and Easter cassia (*Senna pendula*).

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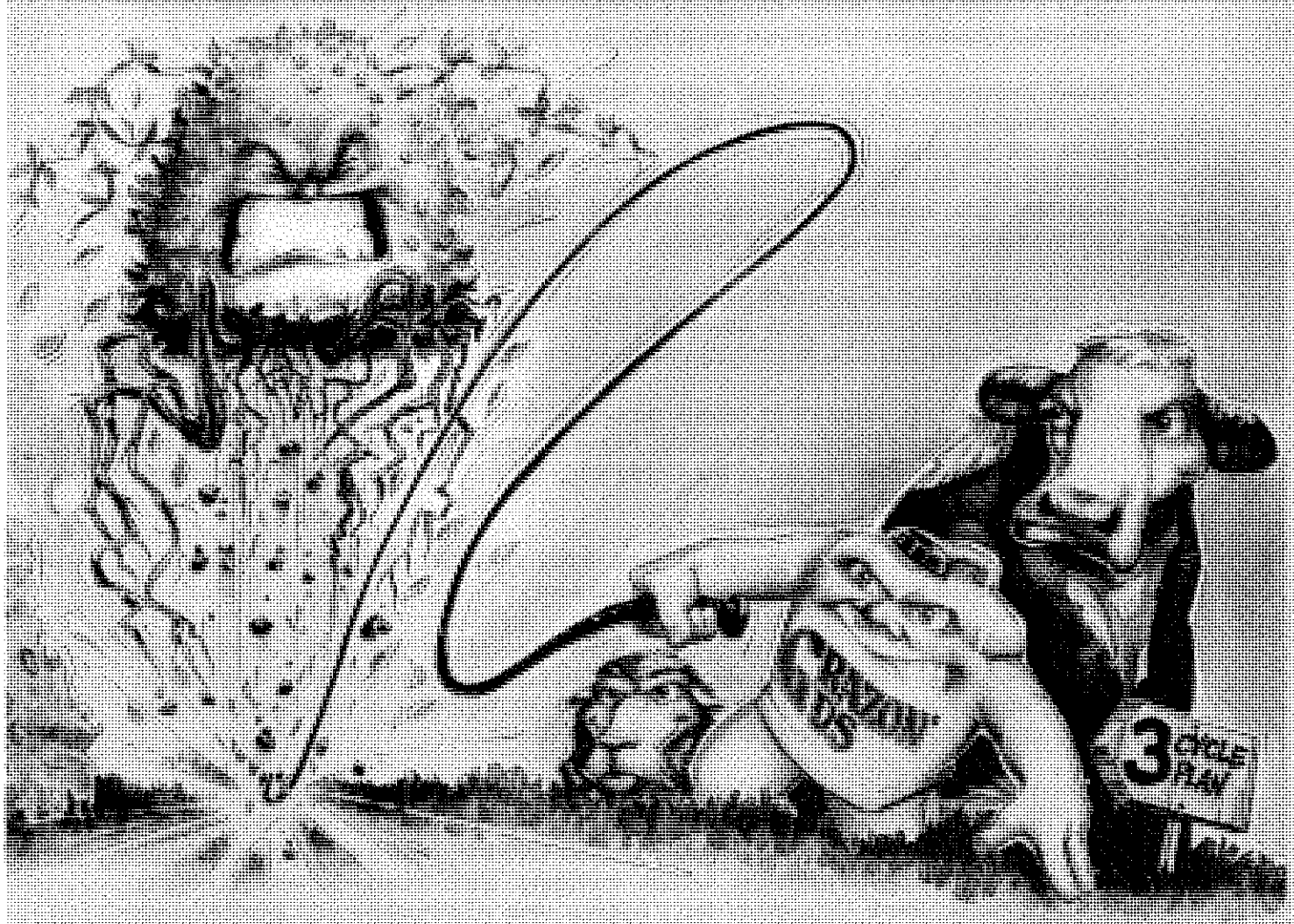
3 CYCLE PLANNER

GET MAXIMUM BENEFIT FROM THE MONEY YOU SPEND



The **3 CYCLE PLAN** is a 5 step programmed approach to woody weed control. A single treatment will not always control woody weeds and some regrowth may occur. If follow-up measures are not carried out the infestation may easily return to the original state with the initial investment being wasted. Aim for long term control.

- **STEP 1** Define the problem
- **STEP 2** Develop a program
- **STEP 3** Develop solutions
- **STEP 4** Create a financial plan
- **STEP 5** Calendar your activities

0800 257 361

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OR CONTACT:

PROMOTING YOURSELF THROUGH PLANNING

K I Fishpool
NSW Agriculture, Orange

A satisfied client (a householder, rural land holder or your supervisor) will sing your praises and promote you to others. A well executed plan, or contract, will ensure that you have a satisfied client group.

There are a number of steps necessary to put together a plan that will achieve this result. Your plan is about knowing your clients, negotiating desired changes, and agreeing on a contract of achievements.

1. Everyone has a group or range of clients no matter where they sit in an organisation. Who are these clients for you, and have you taken the time to identify them in generic or specific terms? In generic terms they are:- consumer, retailers/wholesalers, processors and business proprietors, other Government and Local Government Departments, commercial establishments, house or land holders, and peers or work colleagues.

2. Planning is about negotiating specified achievements or change, with those specific client groups, which meet their needs and fall within the capability of your resources.

These changes or achievements fall into five types: product change, knowledge change, skills change, adoption or behavioural change.

Negotiation also requires skill in being able to prioritise what are the most important achievements that must be attained. You will have limited resources of skill, person power, time and money, so the demands must be held within the probability of achievement.

The issues can be prioritised through negotiating on two scales, namely urgency and potential impact, and using this matrix.

Priority Setting Matrix

	POTENTIAL IMPACT			ISSUES
				1
URGENCY	LOW	SIGNIFICANT	MAJOR	2 3 4
Low				5 6
Significant				
Pressing				

Only issues that fall in this part of the matrix should be considered for inclusion in your plan.

3. The plan that will promote you is the contract, that you have negotiated with your clients, which clearly defines projected achievements and the products and services that will be delivered.

Where you sit in the organisation of council will determine the types of achievement that you will be expected to attain. However, there is a hierarchy of these achievements that are interconnected and contribute to the final achievements of council at the apex of this hierarchy.

This hierarchy of achievement can be defined at any level by asking:

Q.1 "Who are the clients and what is the desired change with these clients in the next 12 months?"

The contract that you want to have in place also has four more questions that must be answered.

Q.2 "What are our/my products and services to effect or bring about these desired changes?"

Q.3 "What are the measures or criteria for success?"

Q.4 "How do I/we collect data to verify this success?"

Q.5 "What resources do I/we commit to this part of the plan?"

In planning terms:

Q.1 will identify goals/objectives

Q.2 the strategies and activities to be undertaken

Q.3 the performance measures, to be used for success

Q.4 the evaluation process, and

Q.5 defines the inputs to be used

So lets see now how all levels in your organisation can be related, to show how each level of your organisation can interconnect and contribute to the attainment of the council as a whole. I have assumed, for this exercise or cascade, that there are five levels of management in your organisation. If there are more or less in your organisation you just add or subtract a column at your convenience.

Council	General Manager & Directors	**Division**	**Section eg. (Weeds)**	**Individual**
Mission				
Goals	Mission			
Objectives	Goals			
	Objectives	Goals		
	Strategies	Objectives		
		Strategies	Objectives	
			Strategies	Objectives
				Strategies
				Workplan-Action Activities
Performance Measures	Performance Measures	Performance Measures	Performance Measures	Performance Measures
Evaluation process	Evaluation Process	Evaluation Process	Evaluation Process	Evaluation Process
Inputs	Inputs	Inputs	Inputs	Inputs

The two new terms in this diagram are "mission", which is a statement about the purpose of the elected council and/or the organisation under the general manager; and "goal", which is a statement of long term change (say 3-5 years) with specified clients.

You will notice that there is a direct link between a strategy in one column and an objective in the next to the right, as the direction for planning is from the left for guidance to ensure inter-connection throughout the plans. For example, your section may have a strategy of having rural land holders provided with information of their responsibilities for noxious weed control. You may have an objective that states "having 50% of rural landholders aware of their responsibilities for noxious weed control".

Having established your objectives it is then important to clearly define the products and services that you might provide at your level. For example, they may fall into these type of statements.

General Manager/ Directors/ Division	Section	Individual
* Technical publications * Group activities eg. meetings * Codes of Practice/ Industry guidelines developed (LEP) * Management Statements Developed * Surveys, market or evaluation research * Product descriptions, market plans developed with clients * Activities for training in skills * Establishments inspected * Establishments accredited * Policy documents developed * Samples tested or plans reviewed * Quality manuals developed * Reports presented	Media activities	Press releases, newsletters, radio, video tapes, TV, presentations at meetings etc, brochures, stickers, or folders
	Client visits	Rural landholders, dwellings, businesses, commercial premises, industrial sites, building sites, Govt depots etc.
	Investigations	Experiments, demonstrations, literature searches, evaluation, inspections of areas and mapping.
	Publications	Technical bulletins, technical conference proceedings, booklets, quality assurance instructions.
	Sponsorship	Consultancies, commercial liaisons, joint projects, grants.
	Groups	Field days, meetings, conferences, workshops, short courses.
	Planning	Work plan, project, strategic or management (assets, vehicle, OH&S), staff appraisal, training, policy, client development.

The contract I/we have negotiated with our external clients or supervisor (as a client) should have clear performance for both objectives and strategies. These can be expressed in terms of : deadline; ratio; percentage; number; or proportion.

Data to verify this can be collected in a number of ways including gut feeling, checking of records, working with groups and surveying through telephone or questionnaires.

Your inputs or resources are important so don't miss these in the contract viz skills, person power, money and time.

SUMMARY

What I have given you may sound complex but it is really only having to answer my five basic questions. If you have done that well, and then executed the plan with your client group, you will meet their expectations and they will sing your praises.

-ooOoo-

MAPPING WEEDS ACCURATELY USING GPS

Peter Terrett
Global Star

This paper assumes that you have little or no knowledge of GPS. For ease of explanation and to deliver the most appropriate concepts some parts of the explanation will be left out otherwise we would spend to long explaining concepts which although important will take up time for little gain. e g I have said that S A is achieved by dithering the clock output, this is true but also can be achieved by transmitting an incorrect ephemeris, you should be able to understand that statement by the end of my talk. To gain good results from your GPS, as long as you understand that your position can be and is degraded, what the likely effect is, and how to minimise or void it, is all that is really important.

Note also that I may tend to jump around a little as a concept may be relevant under a couple of different headings.

1. Brief Overview of the G P S system

GPS or Global Positioning System was developed by the United States Defence Department at the cost of around 12 Billion US dollars, and is designed to overcome the age old problem of navigation and positioning in all regions at all times of the day, regardless of weather conditions (including zero visibility) with a high degree of accuracy.

The GPS system, also known as Navstar (Navigation Satellite Timing And Ranging) uses 24 satellites which circle the earth at around 14,000 kilometres per hour at an altitude of nominally 20,200 kilometres above the surface of the earth and in orbits which are inclined at 55o to the equator. The high altitude is used to avoid the problems encountered by the gravitational effect of the earth.

2. How Position is Determined

The satellites' positions are known for each moment in time and they contain highly accurate clocks and computers which transmit precise time continuously. The signals that are sent out by the satellites travel at the speed of light (186,000 miles per second) and by determining the time taken to travel from the satellite to your GPS receiver and multiply it by the speed of light we can determine the distance to the satellites. It is as simple as saying that if we travel for one hour at 100 kilometres per hour we will have travel a distance of 100 kilometres.

By calculating the distance to three (plus knowing our height) or four satellites we can determine our position by simple trigonometry. The extra reading (i e 4th satellite or height) is required to perform a complex mathematical calculation to solve our own GPS receivers clock error, i e to synchronise our inexpensive GPS clock with the satellites very expensive clocks which are said to be accurate to one second in three million years.

3. Important Factors in selecting a GPS receiver for Weed Mapping

GPS may be the answer to your prayers, but here are a few more questions to consider

1) Performance required both in dynamics and low signal environments, ie number of channel, circuitry and software and antenna design.
2) Accuracy required, ie autonomous or differential (Code or Phase)
3) Output format, eg AMG and/or Latitude and Longitude

Do not assume that because someone you know is using a particular GPS that it will be the most appropriate for your needs. It may well be that it is, however technological advances or different accuracy requirements or environments etc may mean that there is a more appropriate receiver.

4. Levels of accuracy

An inexpensive receiver can deliver accuracy's of around 25 metres under the right conditions. So what does effect the accuracy you can achieve in the field ? First and foremost is the infamous Selective Availability (S A) which is the purposeful degradation imposed by the U S Dept of Defence. S A is imposed almost all the time for security reasons.

The results in that for 95% of the time you will be within 100 metres, 99% of the time you will be within 300 metres, the other 1% you error could be much greater.

Selective Availability is achieved by dithering the clock output from the satellite and effects the computed distance (range) between the satellite and your receiver. Other errors include satellite clock and orbit errors, ionospheric and tropospheric errors. We can improve the integrity of our computed position in a number of ways.

The first is to use a GPS that is capable of averaging a position over a user selected period of time. By taking the average of say 5 minutes observations we will effectively mean out the gross errors as well as smooth our answer over a longer change in S A and satellite geometry, also know as Dilution Of Precision or DOP.

To increase our accuracy better than averaging we need to employ differential GPS techniques. This is where we reference a base station on a point of known surveyed value and use it to resolve the errors at a remote point.

There are several different methods. The first is where our receivers are able to run an average on a predetermined combination of satellites. We need to start and stop at the same time at both stations and as mentioned use the exact same combination of satellites.

At the base we resolve the difference between what we averaged and what the actual coordinates are then apply that difference at the remote station. This method will generally yield an accuracy of 2 - 5 metres. It is not used very often these days as it is cumbersome compared to other methods.

The next method is where we determine the range error (distance) for each in view satellite at the base and apply those corrections to the satellite ranges used at the remote station. To explain; we know the position of the base station and we also know the position of the satellites, we can therefore deduce the distance between them. We also calculate the range based on the speed of light multiplied by the time of travel as previously discussed to deduce our pseudorange. By taking the pseudorange from the known distance we get a range correction for each in view satellite.

These corrections can be applied either as a realtime correction by using a communications link, e g radio, telephone or satellite link or post processed. The format for real-time differential corrections is known as R T C M S C-104 (Radio Technical Committee Marine, Special Committee 104) and is the industry standard as supplied through the various service providers listed below.

The post processed method is achieved "after the event" by combining the base and rover files in a computer program so designed for the task. There is a standard interchange format which is supposed to allows files from different receiver manufactures to be post processed together called RINEX (Receiver INdependent EXchange format). It should be noted that not all RINEX is exactly compatible. RINEX data is not available from the JJJ or AMSA real-time base stations, for post processing you would need to access an appropriate base station.

The great thing about Pseudorange corrected differential is that your remote station could change satellite combination several times due to obstructions etc and it does not unduly effect the differential correction as it will only apply the corrections to the satellites it is using, i e the remote will only use say four satellites whereas the base station will read at least eight. Depending on the quality of the equipment being used and other factors such as the DOP, sub metre accuracy can be achieved.

Generally to get better than say one metre accuracy you need to have a receiver that will measure the carrier phase (wave length) and difference it against a base stations carrier phase. Where the range measurement is simply the distance from the satellite to your receiver as determined by multiplying the speed of light by time, the phase measurement is the actual distance from one wave length to the next multiplied by the number of wave lengths.

By either smoothing our range measurement thereby removing most of the inherent noise or using sync timing or over determination we can achieve sub metre accuracy differentially corrected or differencing the carrier phase with a compatible base station we can achieve centimetre accuracy. We can greatly increase our accuracy, but at much greater cost in equipment, expertise and in time.

5. Real-Time Differential Services Available

The achievable accuracy of an autonomous GPS is system dependant more so than receiver dependant. By applying differential corrections to the rover GPS we can correct for most of these errors

The advantages of using a Real-Time DGPS message include:

- No post-processing for differential positioning
- Real-time Q A, I e Real-time D O P display to indicate accuracy
- Real-time navigation back to a position

There are now several options for real-time differential GPS correction message services in the industry standard R T C M S C-104 format.

Australian Maritime Safety Authority (AMSA)

AMSA have a base station at Cape Schanck which has been set up for marine safety. It transmits on 314 Khz so the signal coverage varies with weather conditions. To

access the signal you would require an MSK receiver decoder and this can be input directly into an appropriate GPS receiver as it is in the Industry standard format. The signal can be used in land in areas close to Cape Schanck however because of the nature of the signal it is not used wildly inland.

AUSNAV

AUSNAV is the name given to the service provided by Auslig and DCI. Base stations are set up in various centres and the R T C M message is then transmitted via the sub carrier on the JJJ FM radio frequency. There are various levels of accuracy which can be subscribed to at different prices. The hardware is purchased and the service is subscribed to.

Omni-Star

Omni-Star is a service that is available right across Australia. A network of base stations around Australia are monitored in Perth at the control centre then uplinked to the Optus Communications satellite for continuous transmission. An Omni-Star receiver is required and their are several types of service available.

Single Reference Station	The user can select which base station is to be used for the correction. This would usually be the closest one to the work area.
W A D S :-	Or Wide Area Differential System A service that delivers sub metre accuracy's anywhere in Australia, includes GPS.
Omni-Star Plus:-	Also know as Virtual Base Station, similar to WADS but requires far less user intervention, delivers sub metre accuracy's anywhere in Australia (receiver dependent).
GPSNett:-	Similar to the Omni-star Plus, but includes the GPS, position are output either to the display or via a serial port. Note that only WGS84 coordinates are supported and is design to be an OEM type of product.
TelePhix:-	Similar to Single Reference Station but instead of requiring an Omni-Star receiver , the user simply dials a 1900 number and receiver the R T C M correction via the telephone from an appropriate base station. TelePhix has not been released as a service yet.

Mobile Radio

Some client needs require them to rent or purchase a GPS base station with radio transmitter, the GPS antenna being placed over a point of known surveyed value. The R T C M messages are then transmitted to a roving GPS system with a radio receiver. The places where this may be appropriate include rural or remote users with many roving units such as some intensive griding work for mining companies or perhaps agricultural research projects which have short busts of intensive use such as at planting and harvesting time.

6. Importance of Satellite Geometric Strength (D O P)

While discussing accuracy we should also cover the geometric strength of the satellites constellation we are using in a position fix. You can maximise your accuracy if you are aware that a poor spread of satellites about the sky will not deliver the accuracy's of a well spaced constellation of satellites. It really gets down to basic trigonometry.

If you only have a 180o view of the sky due to antenna obstruction then the geometric strength known as D O P (Dilution Of Precision) will not deliver the accuracy of a full 360o view. This is why the height derived from an autonomous (stand alone) GPS will generally be 2 to 3 times the error of the horizontal position. That is to say that if your horizontal position is 100 metres out (300 feet) then your vertical position could likely be 300 metres out (900 feet).

There are many D O P values, the most referred to are HDOP (Horizontal) and PDOP (Positional or 3 D). Many GPS receivers will give you a DOP value on the screen to aid you, the closer to the value of one the better and approaching a value of 12 is getting shaky.

7. Environmental Considerations

The GPS signal is very weak and has a hard job getting through trees etc. If you have a cheap receiver or a single channel receiver you may experience quite a bit of frustration in gaining a position under tree canopies. A multi channel receiver will track down to a much lower signal to noise ratio than a single channel receiver. An active antenna is more sensitive than a passive antenna due to having a preamplifier built in. It does require a voltage to drive it and this is supplied via the antenna wiring.

If you are working in a high dynamic mode, say a helicopter for plotting weed locations, then again a single channel receiver will not deliver accuracy as it must smooth its readings over a longer time period than say a six channel receiver which is solving its position based on reading its solution on parallel channels, I e it reads all satellites in its current solution simultaneously plus monitors the next best satellites in case it has to change due to an obstruction etc.

Another consideration with GPS, particularly in an urban environment is the effect of multi-path or reflected signal. This is where the GPS signal bounces off things such as buildings etc. Use GPS within its operational parameters and it will serve you very well, however in suburban or town environments GPS should be used with both experience and caution. Similarly when plotting weeds near haysheds, machinery buildings or silos etc, caution should be used.

The number of satellites above the horizon and their position is changing throughout the day (See diagram 1 for available satellites above 5o elevation and diagram 2 for available satellites above 15o elevation). This effects the DOP values as well as your opportunities in very shaded (say timbered) areas.

As discussed earlier the satellites are in orbits inclined at 55o to the equator and this should be taken into account in that there are no satellites to the south below about 65o for approximately 30o each side of south. (see diagram 3) The exaggeration of this is at the south pole (See diagram 4).

Diagrams 5 and 6 show the PDOP and HDOP values for a 24 hour period based on an unobstructed view of the horizon whereas diagrams 7 and 8 show the effect of not being able to view satellite 12, note the increase in DOP values. Diagrams 9 shows a sky view with obstructions with diagram 10 showing the resulting HDOP.

8. Map Datum and Projection and the Australian Map Grid

Often not understood but very important is the difference between a map projection and a map datum. Most GPS receiver will have an Australian Map Datum, this is not the Australian Map Grid (AMG). The Australian Map Grid is made up of two components.

1) An Australian Geodetic adjustment being the datum (1966 or 1984)
2) The Transverse Mercator Projection being the map Projection.

In other words if you require the AMG then make sure the GPS receiver you are using has UTM as one of its projection & Australian 66 or 84 as one of its datums.

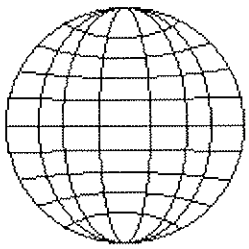
Without question, the Australian Map Grid (AMG) is the most widely used and best map reference system for land use in Australia. It is the basis for most Federal and State mapping, is widely used by map users of all kinds, whether they be for mining, search and rescue, administration or recreation etc.

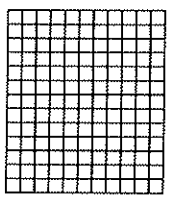
When referring to the AMG we are really referring to the Universal Transverse Mercator (UTM) map projection with a particular map datum, for mapping, usually Australia 1966, Australian 1984 in Queensland and Western Australia. Note that the difference between 1966 & 1984 is generally only a metre or so.

The Universal Transverse Mercator Projection could be likened to wrapping a large sheet of paper around the earth to form a cylinder which touches the earth at the equator. The lines of longitude are then projected out onto the paper such that they become parallel. The natural extension of this projection would be that the north and south poles would become a line across the top and bottom of the map and because of this increasing distortion the UTM projection is only used within 15 degrees of each pole.

To allow for the distortions which do occur, the UTM is divided in to zones six degrees wide and are numbered from zone one to zone sixty. The zones across Australia go from zone 49 (just clipping the edge of W A to zone 56 in the east of Australia. Note also that for convenience of referencing, the zones can be broken done vertically to be eight degrees high, see the included map which is diagran 12.

Geographical
Latitude - Longitude





Universal Transverse Mercator
UTM / AMG

To explain projection and datum a little more, if I was to say that my house was 50 metres above sea level, sea level would be the datum and metres would be the projection. Similarly I could be 52 feet below the Nunawading railway platform, Nunawading railway platform being the datum and feet being the projection.

Most of us would readily recognise the terms of Latitude and Longitude, however for use on land they are not as user friendly. I can assure you of this based on more than 14 years as a topographic and geodetic surveyor with the Department of Survey and Mapping.

The AMG is so well adopted that you will find it on the Melbourne street directory, Melways the ESMap series around Melbourne, the VicRoads directory, the UBD and Sydway in Sydney as well as most if not all topographical maps produced by the various state and federal government departments. The small writing usually along the bottom or side of the map will indicate that the map is based on the Australian 1966 (or 1984) Survey Datum and the Transverse Mercator Projection, look for the letters UTM (Universal Transverse Mercator) on your GPS.

To explain further, the AMG is a metric system. Each centimetre on a 1:100,000 map is a kilometre. Therefore a 1:50,000 map is two centimetres to the kilometre. To locate yourself on a typical topographical map (sometimes referred to as a military map) you read the figures along the top or bottom of the map (easting) then the figures up the side of the map (northing).

In the case of the 1:100,000 map you will notice along the bottom of the map, two figures every centimetre with a small figure in front of them at each 10 kilometre line. For the northing there would be two small figures preceding the larger two at each 10 kilometres line.
Using the map being diagram 11 we define the position of the south east corner of Billiatt Conservation Park in the following way. Read the small preceding figure (noted at each 10 kilometre line) then the two larger figures to the left of the point you wish to define, e g $^{4}64$, then by measurement or estimation work out how far across the square you are in millimetres. In this case I would estimate one millimetre which represents 100 metres giving us an easting of 464100. Do the same for the northing except that there will be two figures preceding the two larger ones and you will be measuring your millimetres up from the line. Finally work out the Zone you are in if required. Therefore, a complete AMG co ordinate accurate to 100 metres would look this:

Zone 54 H Easting 4 **641** 00
Northing 61 **249** 00

There is a popular method of using the above figures to describe your position which is often referred to as the AMG. As a 1:100,000 map does not extend to 100 kilometres in any direction a six figure reference with the appropriate map name can be used and be unambiguous. To explain, if I described my position as being PINNAROO (1:100,000) 641249 then my position has been described in such a way that it does not repeat on the same 1:100,000 map sheet. This method is used widely by Forestry, Parks, Fire and Emergency Services officers.

All that is necessary is to leave off the first figure in the easting, use the next three and leave off last two figures, and for the northing leave off the first two figures, use the next three and leave off the last two figures..

By inspection and example you will find that it is far easier to define a location using AMG than Latitude and Longitude. Would you have read 35° 01'south Latitude & 140° 36"east Longitude for the point described above. It is interesting to point out that one minute of Longitude equals more than 1.8 kilometres for the above example so that

rounding Latitudes and Longitudes could put you along way out of position. Note also that though all GPS receivers will provide Lat/Long only some also provide the AMG format.

10. Setup After Power Loss

All GPS receivers have a SETUP mode. This is where you setup your parameters such as Metric units (instead of Nautical or English) and local time. If you are using a GPS for the first time I highly recommended that you check the setups to ensure that it is in agreement with what you wish to achieve.

This may be mandatory with some GPS receivers if you are unfortunate enough to completely lose power for a period of time. GPS receivers without an internal lithium battery will lose not only its waypoint library, almanac, time and last fix, but will also default to factory settings of GMT, Lat/Long, Nautical etc and most importantly to WGS84 datum. What this means is that you will be on earth centred datum rather than Australian Datum and your position will be out by around 200 metres.

12. Summary

GPS for weed infestation positioning is potentially a very powerful tool, however it should be used in such a way that the accuracy's achieved are meaningful or else it just becomes a waste of time and money. An inexpensive GPS can be quite simple to use and by using simple method such as averaging accuracy's of well under 50 metres can be achieved. It is important though to understand the principles of operation in order to achieve the desired results. It is similar to a four wheel drive in that the more that you understand the way to operate it the further you will go with it. On some jobs GPS is mandatory for the effective positioning of weeds and there would not be any acceptable economic alternative. Do not be mesmerised by the technology as it is simply one of the inputs into the whole system of weed information and mapping.

GLOSSARY OF GPS TERMS

For many new users of GPS equipment some of the terms used may indeed be a little confusing. A glossary of terms related to the GPS system could take up many pages, for instance a term such as Kalman Filter would be of little value to the user interested in plotting weeds.

GPS	Global Positioning System
Datum	A mathematical model of the earth.
AGD66	Australian Geodetic Datum 1966, the mapping datum used in Vic. & NSW
AGD84	Australian Geodetic Datum 1984, the mapping datum used in QLD & WA
WGS84	World Geodetic System 1984, an earth centred datum which is used by the GPS system.

Note that the difference between the various datums is not constant however between AGD84 & AGD66 is approx one to two metres across Australia and between WGS84 & AGD66 (in Melbourne) is approx 112 metres x 184 metres and in Perth the difference is 140 metres x 148 metres

NAVSTAR	NAVigation Satellite Timing And Ranging
C/A code	Clear Access code or Coarse Acquisition code, the code available to the general public, whereas P code or precision code is available to the military.
DOPs	Dilution Of Precision, a figure used to measure the relative geometric strength of the satellites used in the current fix, the lower the value the stronger the fix. HDOP Horizontal Dilution of Precision, as above but refers to a 2 D, 3 satellite fix which will solve the horizontal position only
PDOP	Positional Dilution of Precision, strength of a 3 D fix.
SA	Selective Availability, the US DoD policy for degrading the accuracy of an autonomous GPS receiver by dithering the timing output or transmitting an incorrect satellite position
AS	Anti Spoofing, similar to S A but applies to the P code
Autonomous	A GPS receiver used alone, I e without reference to a base station.
DGPS	Or Differential GPS is the use of a reference station to provide corrections to the satellite ranges so as to greatly increase the positional accuracy. This can be done via a telemetry link in realtime or by storing the data and post processing
RTCM SC-104	The standard message format for pseudorange differential GPS
Pseudorange	The part of the wave used for simple navigation, very basically the uncorrected time multiplied by the speed of light equals uncorrected distance from satellite to receiver
UTM	Universal Transverse Mercator, a map projection whereby lines of longitude are shown as parallel lines, when selected with AGD84 or AGD66 gives the Australian Map Grid format which is by far the most widely used and best system for navigation and positioning on land
NMEA	National Marine Electronics Association, NMEA 0183 is a standard ASCII text format which enables equipment from different manufactures to communicate with each other, e g a Motorola GPS receiver can drive an autohelm autopilot.
Almanac	Data transmitted by a GPS satellite which includes orbit information on all satellites, clock corrections and atmospheric delay parameters, this data is used to facilitate rapid satellite acquisition.
URA	User Range Accuracy, the estimated amount of error in an individual satellites range measurement, with S A on, generally around 32 Metres
Multipath error	Interference caused by reflected GPS signal which results in a larger range estimate.
UTC	Universal Time Coordinates, uniform atomic time system.
SNR	Signal to Noise Ratio
Acquisition Time	Time needed for the GPS to lock onto the required number of satellites
Waypoint	Locations in a coordinate system on the surface of the earth e g Eastings & Northings or Latitude and Longitude
ALT	Altitude
ATD	Along Track Distance
BRG	Bearing, the direction to your destination
RNG	Range, Distance

CDI	Coarse Deviation Indicator, how far left or right you are from a direct course to your destination.
COG	Coarse Over Ground
CTW	Course To Waypoint
DIS	Distance
DMS	Degrees, Minutes and Seconds
DMD	Degrees, Minutes and Decimal Minutes
OSGB	Ordinance Survey of Great Britain
DMG	Distance Made Good
DoD	Department of Defence
DR	Dead Reckoning
DTD	Distance To Destination
DTW	Distance To Waypoint
ELEV	Elevation
MSL	Mean Sea Level
RTE	Route, a series of waypoints navigated in a specific order
ETA	Estimated Time of Arrival
ETE	Estimated En Route
GS	Ground Speed
TK or TRK	Track, Heading
RADIAL	Bearing from a waypoint to your current position rather than from you to the waypoint
R/B	Range and Bearing
HDG	Heading
KTS	Knots
NM	Nautical Miles
SOG	Speed Over Ground
SPD	Speed
VEL	Velocity
SV	Space Vehicle (Satellite)
TTG	Time To Go
VMG	Velocity Made Good
XTE	Cross Track Error, deviation from your desired course
TR	True Bearing
MG	Magnetic Bearing
AUTO	Often refers to automatically switching between 2D and 3D depending on number of visible satellites and DOP, AUTO should be selected rather than 3D or 2D in most cases for land applications

Peter Terrett is the principal of the specialist GPS company Global Star and a director of Rapid Map Australia. His background is with the Division of Survey & Mapping as a geodetic and topographic surveyor. Global Star is independent of any supplier and provides the appropriate system for end users irrespective of branding. Global Star is involved in solving client problems with either products (hardware or custom written software) or services such as data capture, training or consultancy.

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Email address: info@globalstar.latrobe.edu.au.

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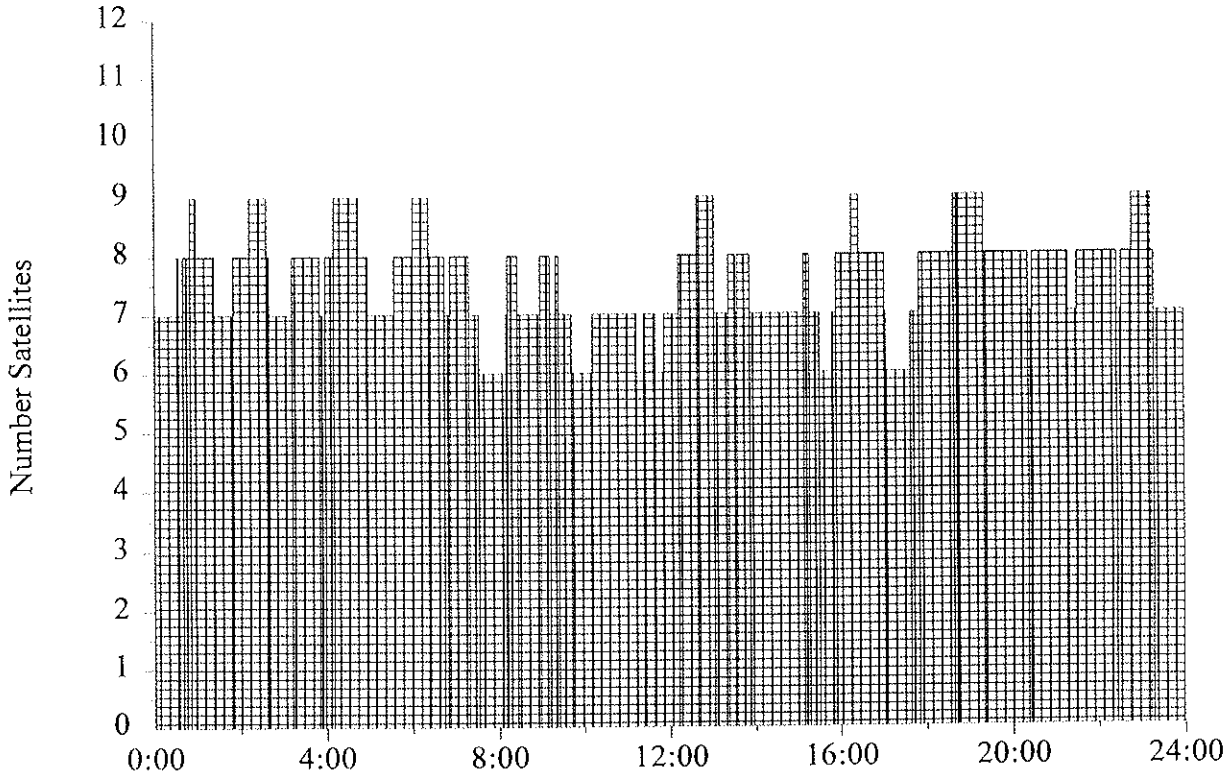

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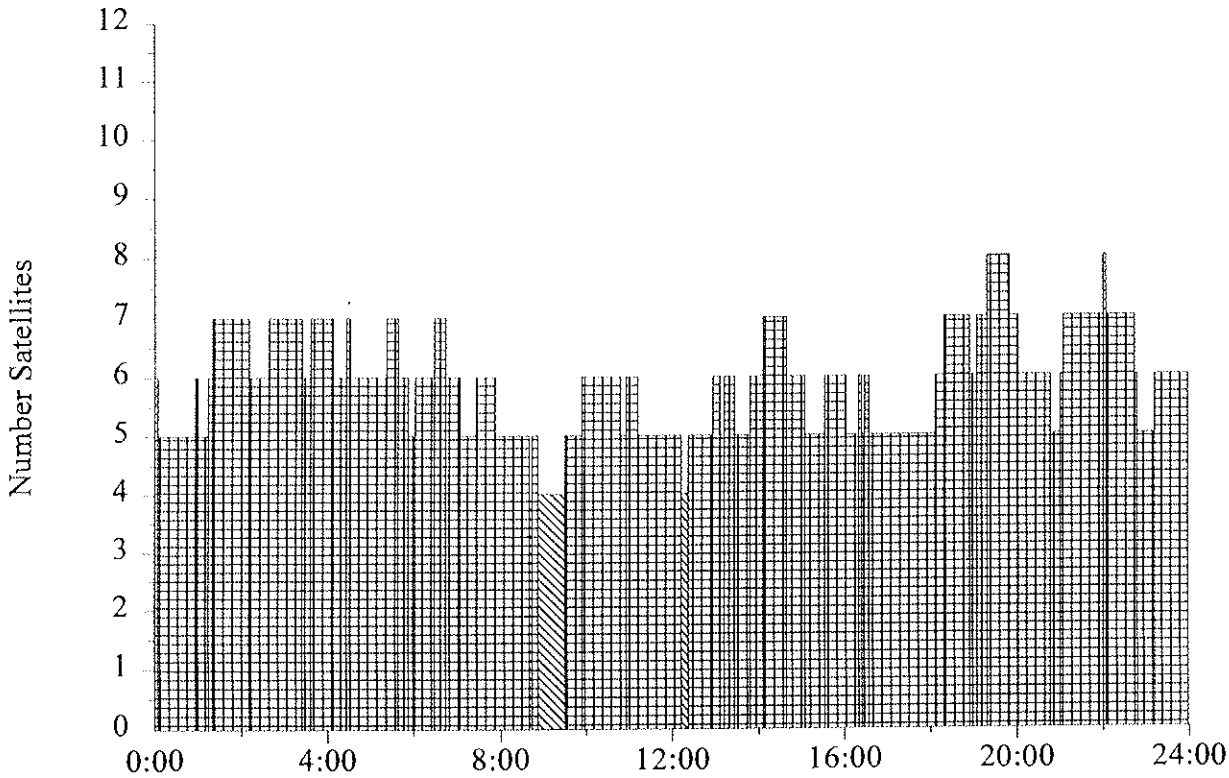

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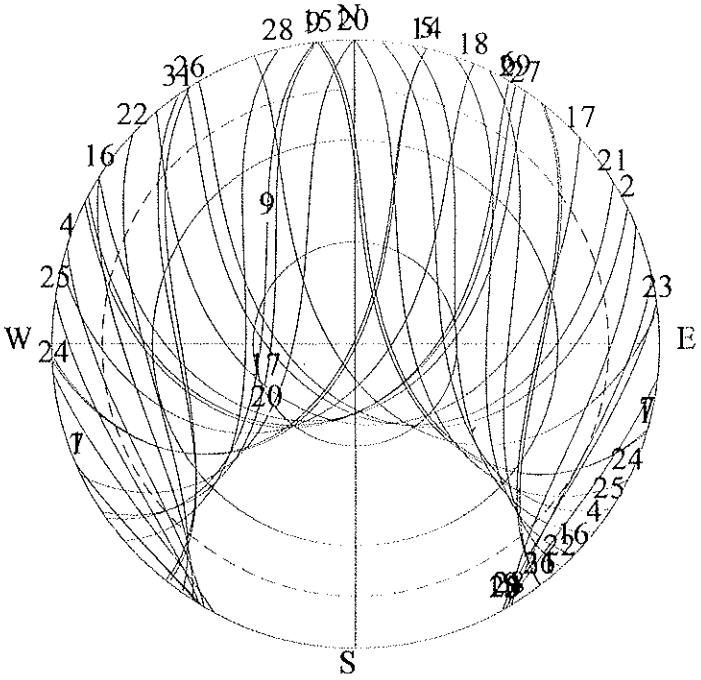

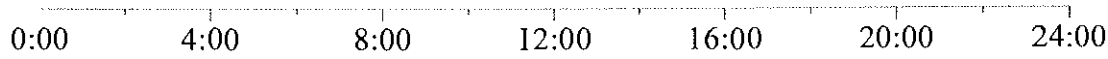

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SkyPlot

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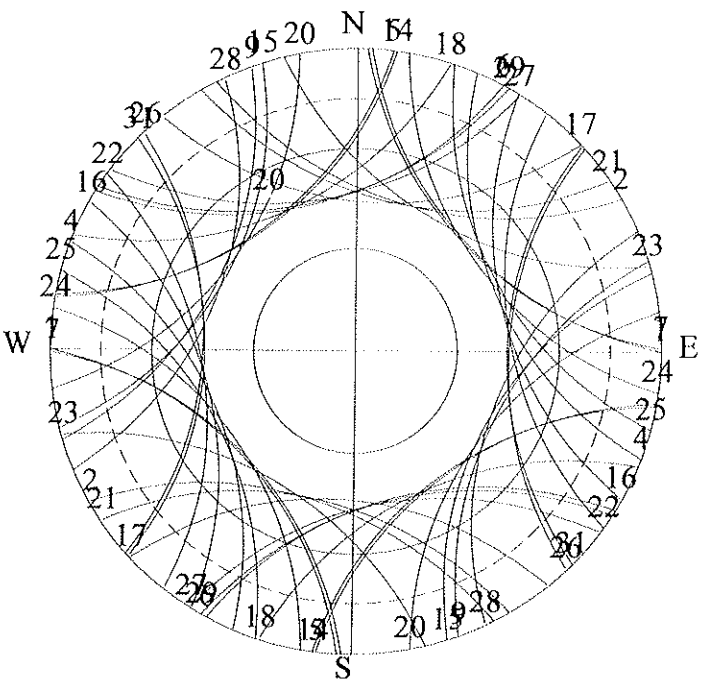

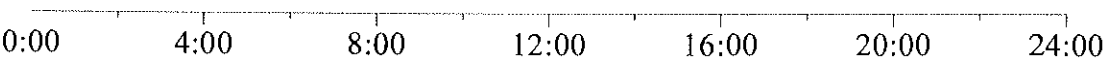

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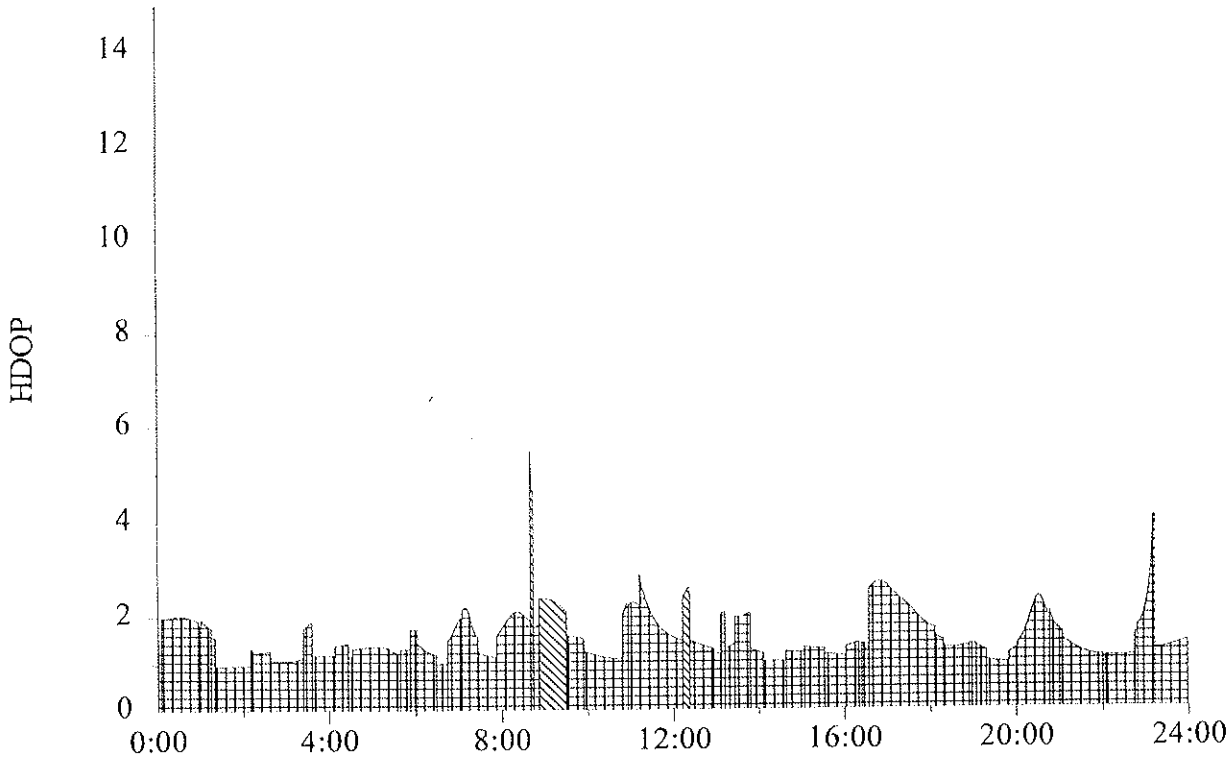

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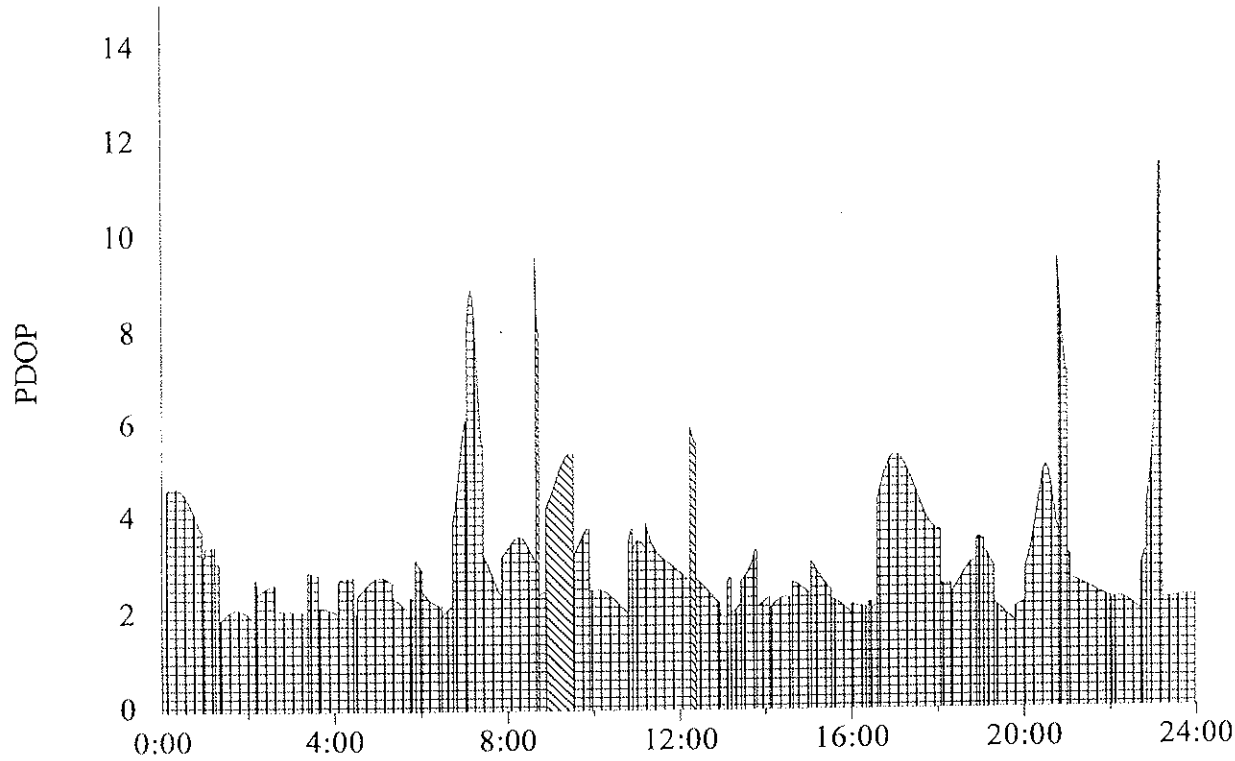

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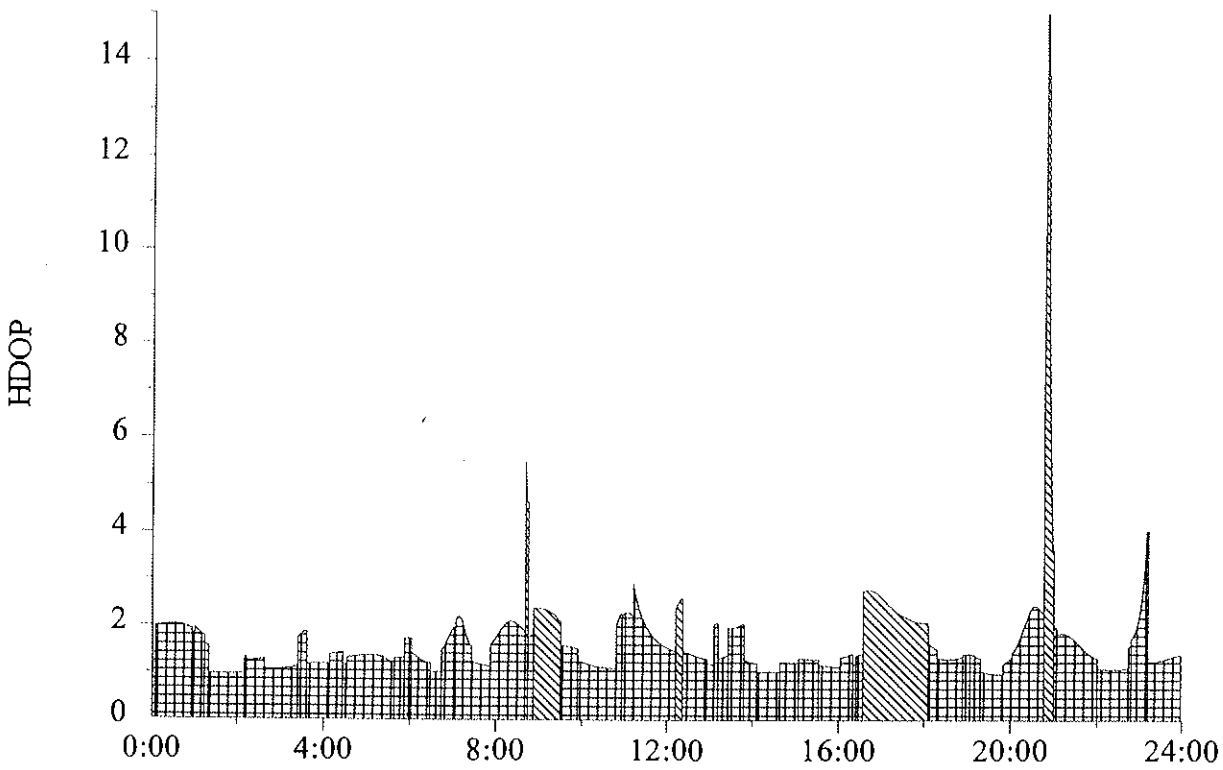

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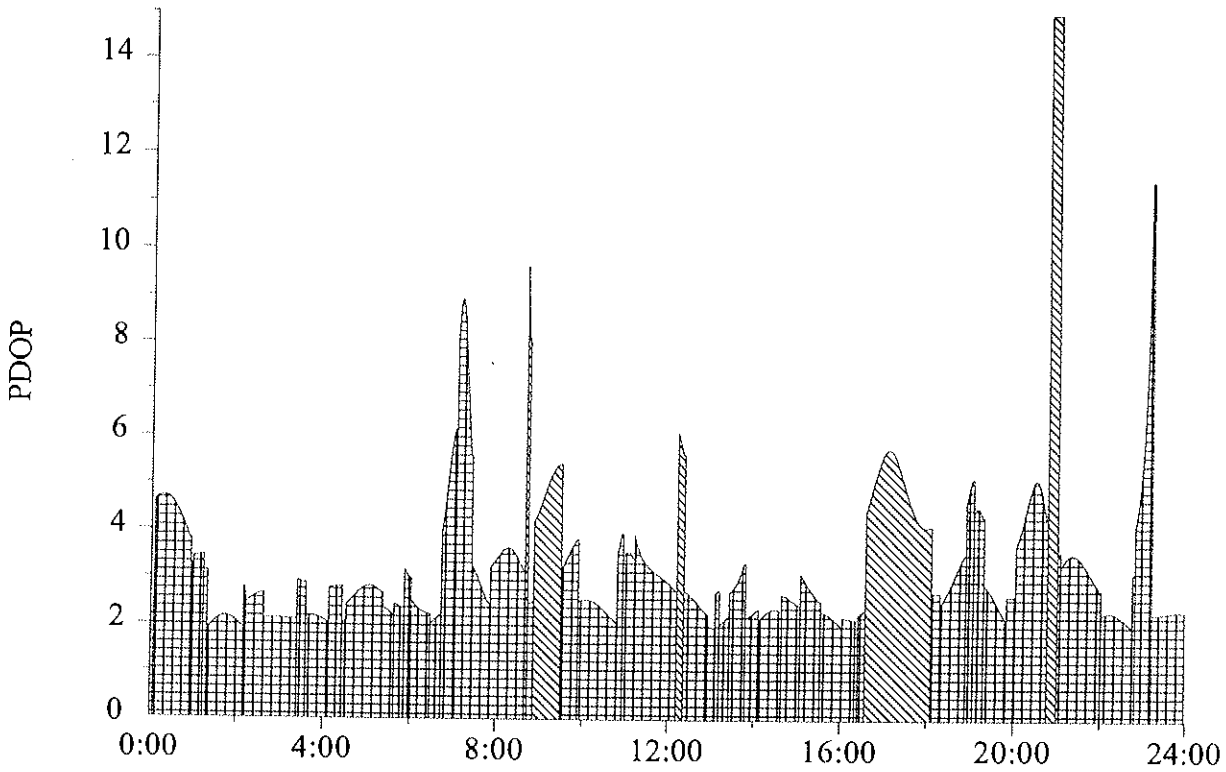

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SkyPlot

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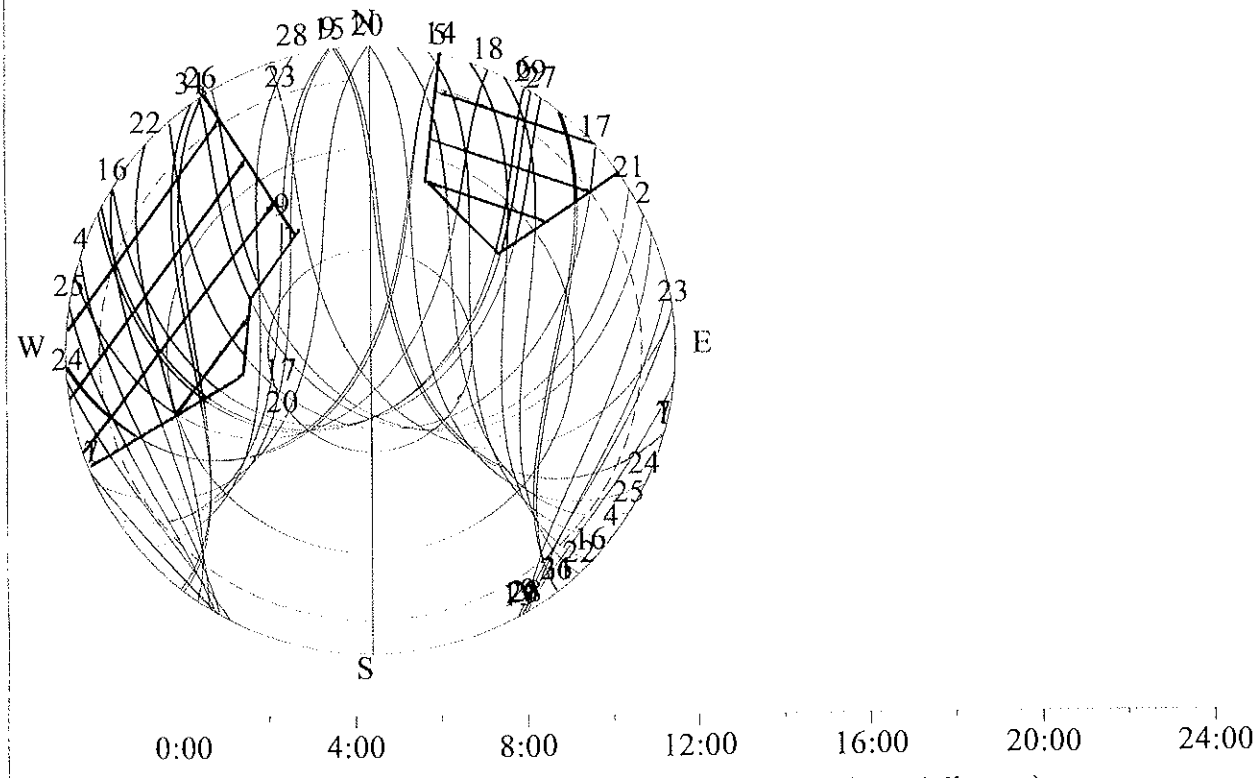

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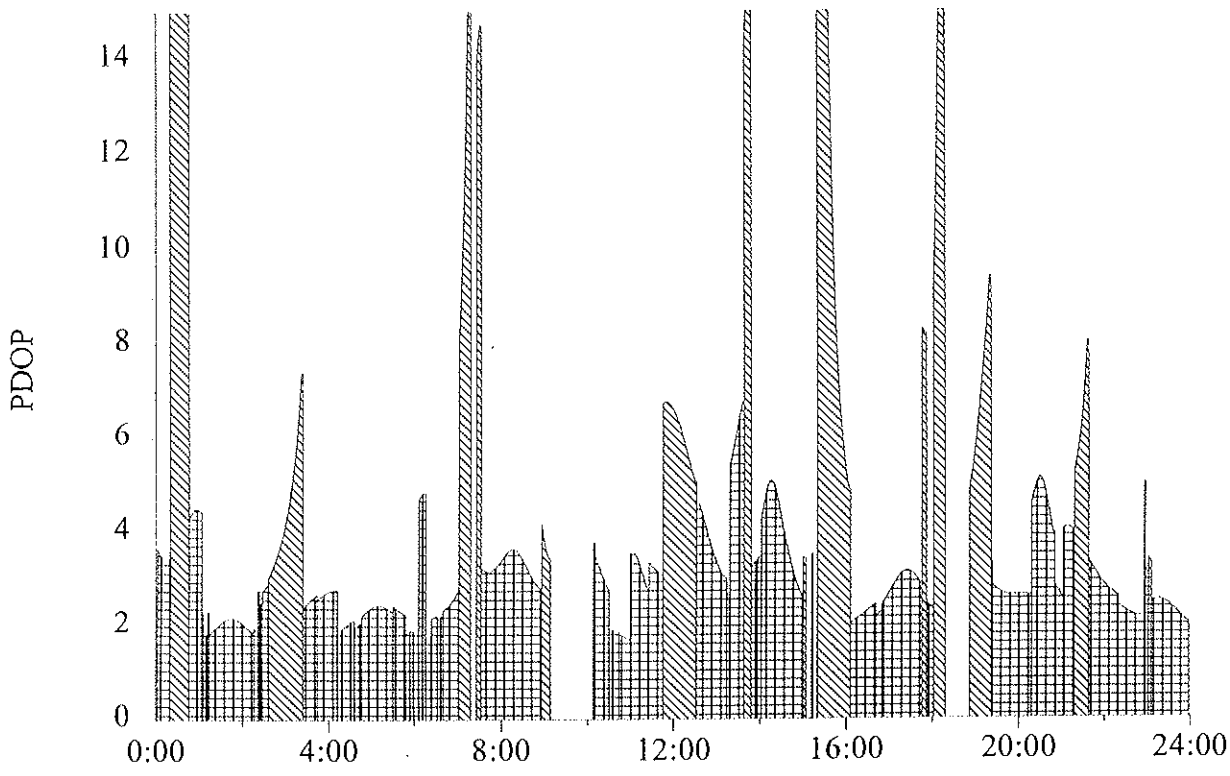

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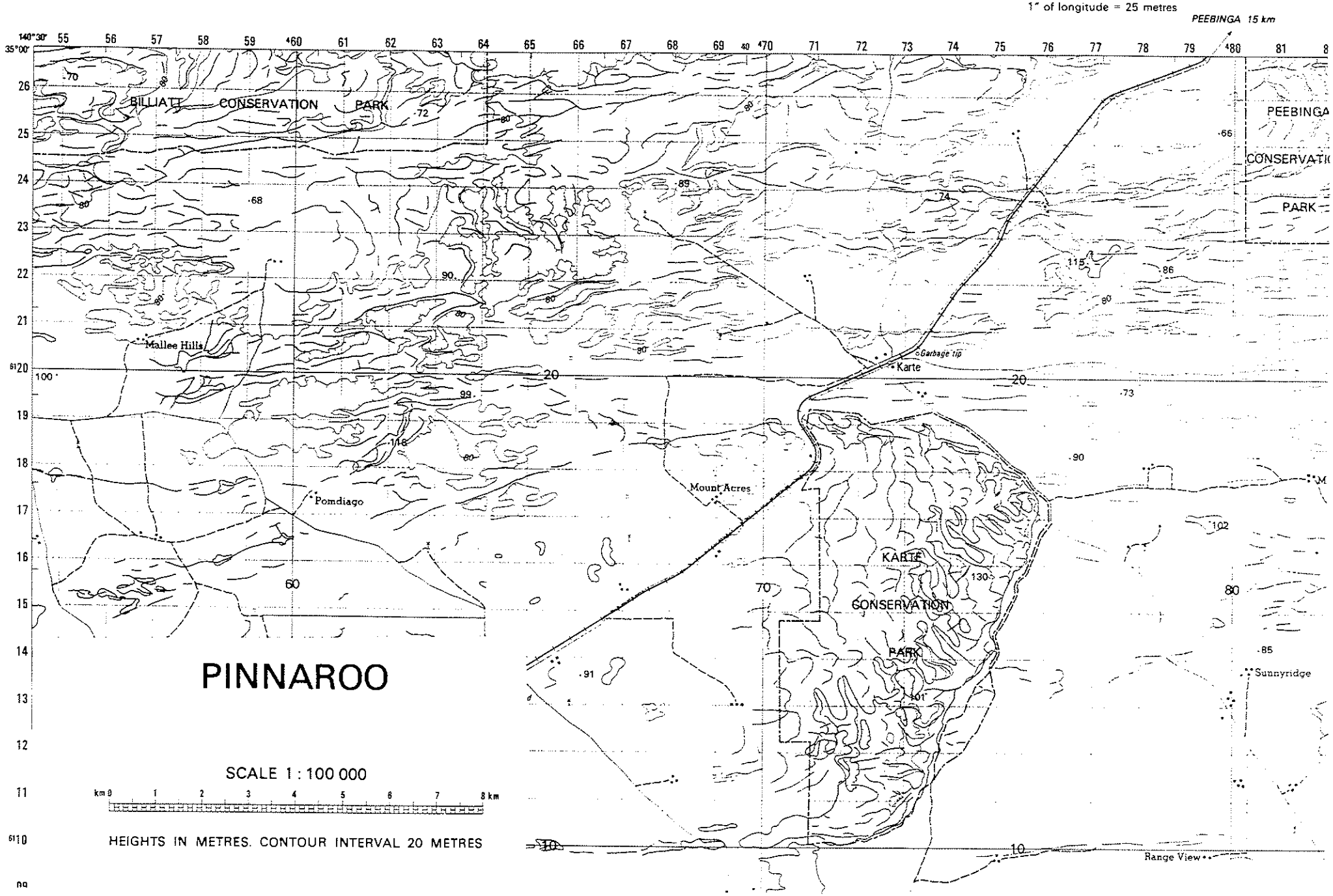
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BILLIATT CONSERVATION PARK
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Pomdiago
Mount Acres
KARTE
CONSERVATION
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PINNAROO
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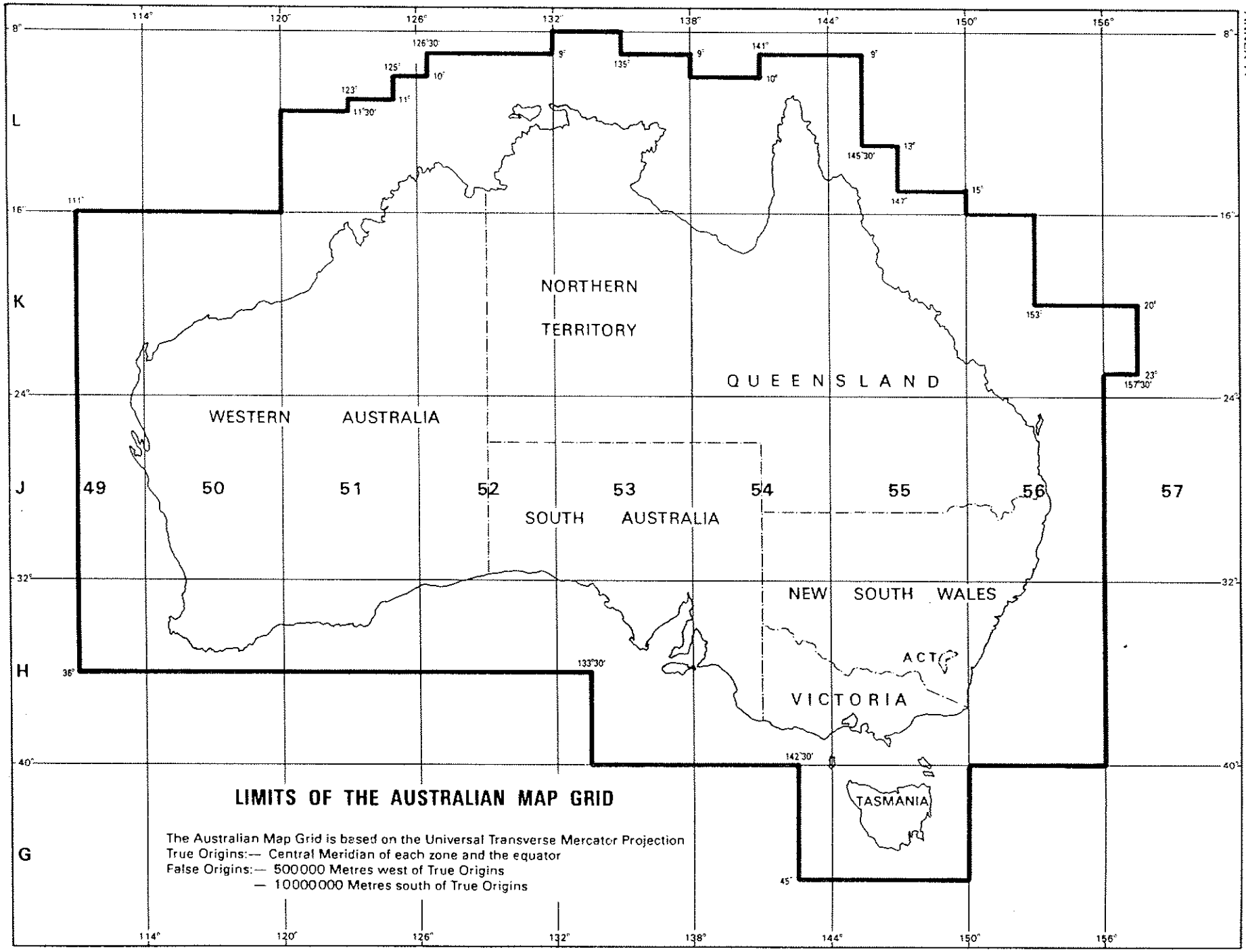
km 0 1 2 3 4 5 6 7 8 km
HEIGHTS IN METRES. CONTOUR INTERVAL 20 METRES



LIMITS OF THE AUSTRALIAN MAP GRID

The Australian Map Grid is based on the Universal Transverse Mercator Projection
True Origins:— Central Meridian of each zone and the equator
False Origins:— 500000 Metres west of True Origins
— 10000000 Metres south of True Origins

LONG-TERM PLANNING SUCCESS IN CONTAINING *MIMOSA PIGRA*

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INTRODUCTION

Mimosa pigra (mimosa or giant sensitive plant) is a prickly leguminous shrub, native to Mexico, Central and South America. It is believed to have been introduced to the Darwin Botanic Gardens prior to 1891, probably as a curiosity plant, or as a contaminant of animals or seed (Miller and Lonsdale 1987).

Concern was expressed about the weed potential of mimosa in the early 1900s, but it did not show itself to be a major problem until the 1960s. Initially mimosa was confined to the Darwin area and it was not until 1952 that it was found in the upper reaches of the Adelaide River. From there it spread downstream to its favoured habitat -the open floodplains - where large monocultures of the plant were reported in the early to mid 1970s.

Spread from the Adelaide River to other river systems commenced in the late 1960s. It now occurs on wetlands from near the Fitzmaurice River in the west to the Arafura swamp in the east (Figure 1). In Australia, mimosa still occurs only in the Northern Territory, but it poses a threat to a wider area of northern Australia, including the river systems of Queensland, Western Australia and possibly northern New South Wales.

Mimosa is most abundant in seasonally flooded or permanently moist areas. It is a particularly aggressive plant, competing with pastures, interfering with mustering and preventing access to water. It also affects the recreational use of land and has detrimental effects on native flora and fauna (Miller *et al.* 1981; Braithwaite *et al.* 1989; Lonsdale *et al.* 1989). However, mimosa is also drought resistant and will grow in upland habitats.

In the Northern Territory mimosa is declared as a Class A noxious weed (to be eradicated) south of 14• S latitude, and as a Class B noxious weed (spread to be controlled) north of this line. Its control is also one of the high priority actions proposed under the draft National Weeds Strategy, the goal being to contain mimosa within the Northern Territory.

Early Planning for Control

Planning for control of mimosa has had a chequered career. The earliest record of control action was in the Darwin Botanic Gardens in 1913 when its control, along with other noxious weeds, was "being taken in hand; and I hope in my next report to be able to state that they are clean of these pests, but the work will take some months to accomplish" (Allen 1914). The vast stands of impenetrable mimosa that now exist in the Northern Territory are evidence that Allen's plan was not fulfilled.

After its spread to the Adelaide River, an eradication program commenced in 1965. The plan was to eradicate it from its uppermost point in the catchment for 35 km downstream. A full-time eradication attempt by two persons, sometimes three continued for six years. The team managed to stop plants seeding within the eradication area, but plants continually reappeared from previously deposited seed

and the infestation spread downstream from seeding plants below the control area (Miller *et al.* 1981).

In 1966 the technician in charge of the program made a request for an extra labourer, but he was told that he was "glorifying the job". The full time eradication attempt ceased in 1971 as the team was fighting a losing battle. However, in 1974 a further proposal was put for a full-scale eradication program costing $647,500 over 12 years. It was not implemented and mimosa continued to spread.

After self government in 1978, a greater interest was shown in political circles about doing something about the escalating problem. It was realised that complete eradication of mimosa from the Northern Territory was not feasible, but that a lot could be done to control and contain the weed. It was from that time onwards that the current plan was born. Increased finance and a gradual increase in staff and physical resources provided for development of the current plan which includes both research and control.

Research Program

Mimosa has many of the characteristics listed by Baker (1965) which make it an ideal weed. These led to many difficulties in achieving control. The prickly nature of the plant, its height (up to 6 metres) and its ability to form dense impenetrable thickets makes access into infestations difficult; the plant grows rapidly, flowers quickly and seeds throughout the year under favourable moisture conditions; it produces large quantities of seed, many of which remain viable for long periods; there is uncontrolled spread of seed by floodwaters, by animals and by man; and the plant is both flood and drought tolerant. These factors have been addressed in developing the research and management plan.

The research carried out on the management of mimosa since 1979/80 has emphasised an integrated approach. Investigations have been carried out into the biology of the plant, biological control, chemical control, the use of fire and competitive species (Miller 1988; Lonsdale *et* al. 1989; Forno 1992). Physical control, while not being formally investigated in a research sense has also been used: hand-pulling, bulldozing, rolling and chaining.

Pitt and Miller (1988) emphasised the importance of having up-to-date information on the location and extent of mimosa infestations in order to design management programs and to assess the effectiveness of control. Hence methods of detecting and mapping mimosa by satellite imagery have also been investigated (Fitzpatrick *et al.* 1990). The use of Global Positioning System technology, combined with remote sensing of base maps, now enables for accurate mapping of infestations.

Other progress builds on experience. Innovations in transport since the 1960s have eased the problems of access to carry out control on mimosa. For example, the use of quad bikes, airboats, all-terrain vehicles, lightweight four-wheel drive vehicles and helicopters have assisted with accessibility into areas that were previously accessible only with great difficulty during the wet season.

The results of this research have provided the means to contain the spread of mimosa.

The Current Management Plan

In 1972, after cessation of the full-time eradication attempt between 1965 and 1971, limited control measures were put in place to slow down the spread of mimosa (Miller *et al.* 1981). These were to control mimosa in areas of human activity along the Adelaide River, as well as total control attempts on isolated infestations away from the Adelaide River. This is basically the same plan that is used today. However, mimosa spread faster than the resources that were applied to the problem and while the basic plan of controlling new isolated infestations still exists, there are some infestations where only limited or no control is carried out, for example in Wagait Aboriginal Land Trust.

The long-term plan for control of mimosa is through the use of biological control agents integrated with other control methods. The basis of the current plan is to contain infestations within the existing range on a regional, catchment and property basis. This requires the eradication of small isolated infestations and containment of larger ones while the biological control research is progressing. Roadside control of mimosa is also carried out as an integral part of the plan, to assist in preventing movement of mimosa to clean areas within the NT and interstate.

For individual properties and districts the aim is to prevent initial invasion of the weed and the eradication of small infestations integrating physical and chemical means. For large infestations, biological control is integrated with herbicide application, mechanical removal, fire and pasture management (Miller *et al.* 1992). The plan is in accordance with the regional eradication and control declarations for mimosa under the Northern Territory *Noxious Weeds Act.*

Control methods

The most commonly used herbicides are tebuthiuron, fluroxypyr, hexazinone and metsulfuron methyl. For maximum effectiveness of herbicides on mimosa it is important to apply them before peak flowering and seeding, to use residual herbicides where appropriate and to follow-up control for many years. Large herbicide treated areas are bulldozed and chained to flatten dead mimosa before burning, and to aid in regeneration of understorey species. Fire results in a higher level of seed germination on the soil surface by scarifying the hard seed coat, and some of the seed on the surface is killed by fire (Lonsdale and Miller 1993). Fire also has a role in control programs by enhancing the kill of plants that have not been completely killed by herbicides.

Mimosa seedlings are susceptible to competition from grasses (Miller 1992). Hence regeneration of native pastures or planting of competitive pastures, combined with close monitoring of grazing pressures, can enhance the result achieved by chemical control. Any regenerating plants must be spot treated.

Integrated control can include the use of incompatible methods in different parts of a weed's range, but these methods can support each other in the overall control program. Hence with infestations which are inaccessible, or cannot be repetitively treated with herbicides, biological control agents alone are being established. Since 1983, seven insect species and one fungal pathogen have been released and all appear to have become established (C.G. Wilson pers. comm.) and monitoring of their impact is continuing. The plan is to attack all parts of the plant: flower buds, seeds,

leaves, stems and roots, but so far no agents have been released that attack the roots.

Effective biological control may also open the mimosa canopy sufficiently to allow for the sowing of pastures or for natural regeneration to occur. Burdon (1981) pointed out that success with biological control agents is often due to interactions with the presence of competing pasture species rather than to the effect of the agents alone. Hence, pastures may interact with the effects of the mimosa biological control agents to produce more effective control.

Co-operation

An integrated research and control program such as this requires co-operation between all agencies and individuals: the various arms of the NT Government, the Commonwealth Government, pastoralists, Aboriginal and other landholders. Co-operation is required in funding applications, to determine the most appropriate control methods in a particular area, to ensure that the methods used do not conflict, and to prevent environmental damage.

In the case of mimosa control on Aboriginal Land, an inter-agency meeting in 1990 resolved to develop a control program. A Public Environment Report was completed (Anon. 1991) before approval of funding by the Commonwealth.

Implementation of the Plan

The largest infestation of mimosa is on the Adelaide River floodplain. It has been estimated at 30,000 hectares. At the time of commencement of the biological control research in 1979 a decision was made not to undertake chemical control of the entire Adelaide River infestation, but to leave it for biological control. However, individual landholders within that area could carry out control if they so desired and the Government would continue with its control program on roadsides within that area to slow down the spread of mimosa to clean areas.

Control away from the Adelaide River is carried out by different agencies in their particular areas of responsibility: The Department of Primary Industry and Fisheries, the Conservation Commission in Territory parks and reserves, the Australian Nature Conservation Agency in Kakadu National Park and landholders. Most small infestations in the Mary and Reynolds River areas are being controlled, but a 7,000 hectare infestation in the Mary River still exists.

In one case, on Aboriginal land at Oenpelli in Arnhem Land, a large isolated infestation (8,000 hectares) is being controlled. If sufficient resources are applied to it in the long-term, this infestation can be eradicated. At the time of commencement of the project, the infestation was on the eastern edge of the weed• s range and posed a threat to Kakadu National Park (Miller and Schultz 1993). The Oenpelli infestation is still the largest in the area, the more recent reports of mimosa further east all being small isolated infestations. The five year control project at Oenpelli commenced in 1991/92, is funded by the Commonwealth Government and carried out by the Department of Primary Industry and Fisheries, the Northern Land Council, the Australian Nature Conservation Agency and the local Gunbalanya Council. A research and monitoring program is carried out by CSIRO Division of Wildlife and Ecology.

The area has been aerially treated with the herbicides Graslan (tebüthiuron) and Starane (fluroxypyr), chained and burnt. Since 1991, 135 tonnes of Graslan have been applied to the area but monitoring has shown that the concentration of tebuthiuron in soils and water are generally well below values that affect aquatic fauna and flora (Cook 1993).
Ground control of small infestations is carried out by Aboriginal teams from Gunbalanya. After some initial difficulties with striping during aerial application, the result obtained has been excellent. Revegetation of areas treated with herbicides is occurring naturally. The native grasses, *Hymenachne acutigluma* (hymenachne) and *Oryza rufipogon* (wild rice), harvested from another floodplain, were sown in some areas but establishment was poor. Maintenance of a competitive ground cover is essential to prevent the re-establishment of seedlings and follow-up control of isolated plants by chemical means is also essential to the continued success of the project.

After five years the project will have cost $6.5 million but it has shown just what can be done to manage mimosa if sufficient planning and resources are applied to an infestation. The principles applied at Oenpelli can be applied to similar or smaller infestations elsewhere. A similar project is being developed for the western edge of mimosa• s distribution in the Daly River/Port Keats Land Trust to supplement the existing program. This area is also Aboriginal land.

Assistance and publicity

The Northern Territory Government subsidises landholders for the cost of mimosa control. The subsidy covers 50% of the cost of approved chemicals used in both aerial application and ground control, and 50% of the cost of aerial application and aircraft ferry. All chemicals used in the herbicide mix - herbicides, wetting agents, anti-evaporant oils and diesel - are eligible for a 50% subsidy. The amount that can be claimed is limited only by the budget allocation in any one year. In 1994/95 the scheme cost the NT Government over $300,000.

In key areas, control is carried out by the Department of Primary Industry and Fisheries free-of-charge on both Aboriginal land and pastoral leases.

Publicity about mimosa, through the print and electronic media at both the national and local level, posters, Agnotes and field days, has assisted in informing the public about the problem and its management, and of the need to report infestations. Increased awareness by Aboriginal landholders in Arnhem Land has resulted in early detection of satellite infestations and better control.

Conclusion

While it is often difficult to quantify the success of weed management under extensive land management conditions, it is clear that if the work outlined here had not been carried out over the past 20 years, mimosa would certainly cover a far greater range than it does today. In the past 10 years mimosa has not spread to the same extent that it did in the 1970s and early 1980s, and it is still contained within a relatively small area of the Northern Territory (0.06%) and an even smaller area of Australia. Continuation of the plan will ensure that mimosa has minimum deleterious effects on Australia's wetlands.

Ultimately the success of a weed management program depends on the execution of an effective long-term plan. However, the effectiveness of a plan is determined by

having a solid research base into the plant• s biology and control; sufficient resource allocation; co-operation and collaboration between all parties; and a long-term commitment to the plan.

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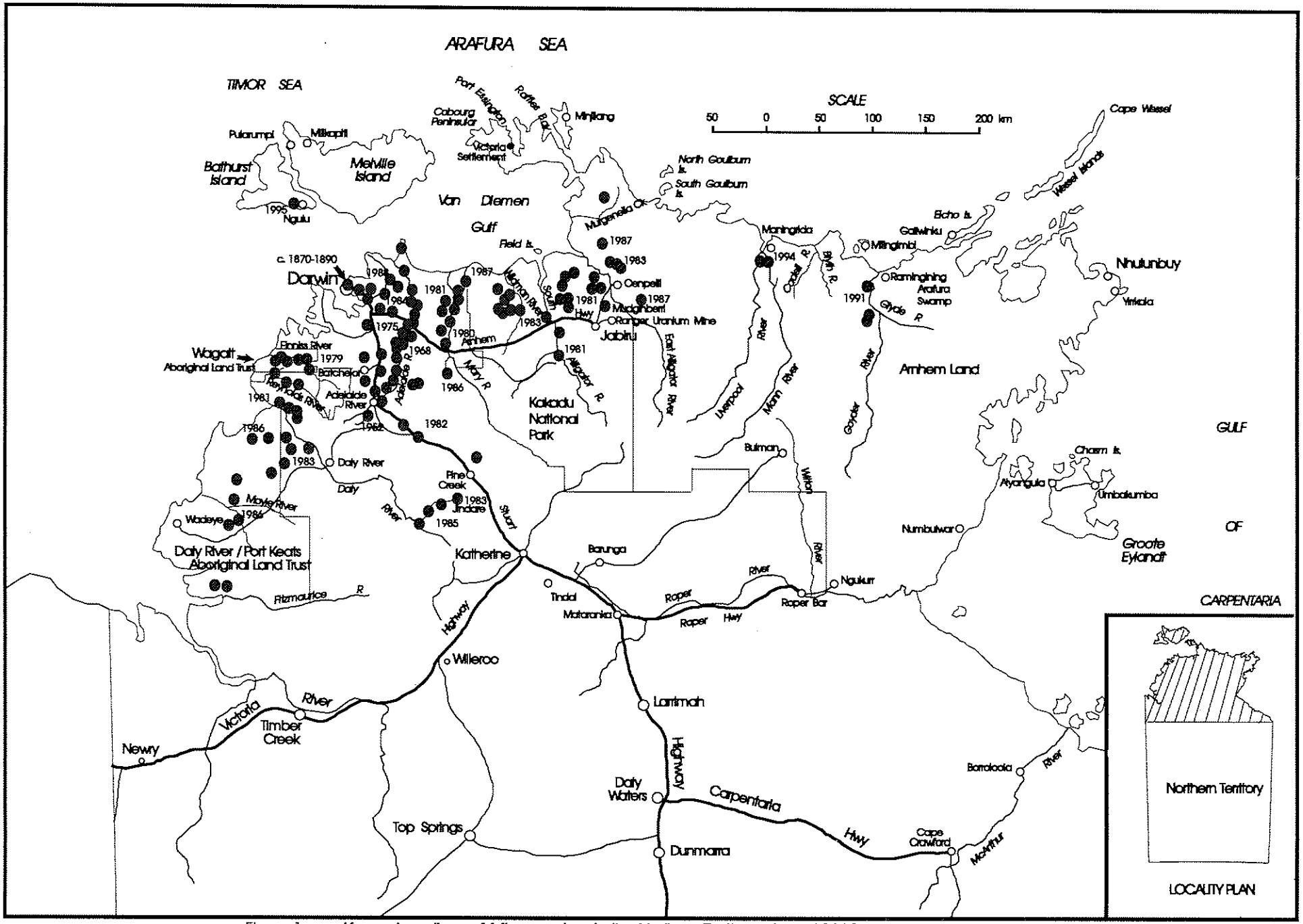

Figure 1. Known Locations of *Mimosa pigra* in the Northern Territory, August 1995 updated from Miller (1988) by G.J. Flanagan and L.A. Hills.

BIOLOGICAL CONTROL OF WEEDS IN NEW SOUTH WALES

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Introduction

The first documented use of insects to control a weed was the use of the cochineal insect, *Dactylopius ceylonicus,* to control smooth tree pear, *Opuntia vulgaris,* in southern India between 1863-68 (Harley and Forno, 1992). Since that time many weeds have become and continue to be the target of biological control programs.

Many current programs relevant to New South Wales are cooperative between NSW Agriculture, CSIRO, Department of Conservation and Natural Resources (Keith Turnbull Research Institute, KTRI, Victoria) and the WA Dept of Agriculture (WADA).

Many of the biological control agents that have been, or are being, reared by CSIRO for release are also being reared by the Weed Biological Control Unit (WBCU) of NSW Agriculture. The WBCU monitors progress of many of these agents. Another group within NSW Agriculture is looking at use of naturally occurring pathogens for control of weeds.

Weed Biological Control Programs Relevant to NSW

Asteraceae

Cassinia spp.

Cassinia spp. are woody shrubs that are found mainly on the tablelands and western slopes. Biological control using native scale insects, *Austrotachardia* sp. and *Paratachardina* sp., is currently being used in limited areas with excellent results (Holtkamp and Campbell, in press). The use of native insects for biological control of native weeds is uncommon.

Bitou bush and boneseed, subspecies of *Chrysanthemoides monilifera*

Bitou bush, *Chrysanthemoides monilifera* ssp. *rotundata,* is mainly an environmental weed of coastal areas of NSW. Bitou tip moth, *Comostolopsis germana*, was first released in 1989 and is now established at many sites in NSW. At one of the release sites the moth has reduced flowering by 50% and reduced fruit production by 70%. Black boneseed leaf beetle, *Chrysolina* sp., has been released in NSW but does not appear to have established. This defoliator appears to be more suited to boneseed, *Chrysanthemoides monilifera* ssp. *monilifera*, which occurs in Southern Australia.

Two other leaf feeding *Chrysolina* species have been released for control of boneseed and bitou bush. The painted boneseed leaf beetle, *Chrysolina oberprieleri*, was released in southern NSW in 1995 and blotched boneseed leaf beetle, *Chrysolina picturata*, was released in Vic and SA in 1992.

Permission has been granted for the release of the seed fly, *Mesoclanis polana,* and another defoliating beetle, *Cassida* sp. Testing is being carried out on other potential agents which include two other seed flies, *Mesoclanis dubia* and *Mesoclanis magnipalpis*, a leaf rolling moth, *Tortrix* sp., and the rust fungus, *Aecidium osteopermii.*

Nodding thistle, *Carduus nutans*
Nodding thistle is a pasture weed that is mainly found on the tablelands of NSW. Three agents have been released for control of nodding thistle. The receptacle weevil, *Rhinocyllus conicus*, the seed-head fly, *Urophora solstitialis* and the rosette weevil *Trichosirocalus horridus* have all been released in NSW and have established in the field. NSW Agriculture and CSIRO are continuing to breed and release the seed-head fly and the rosette weevil. Another potential agent the stem fly, *Cheilosia corydon,* is undergoing testing.

***Onopordum* thistles**
Scotch thistle, *Onopordum acanthium*, Illyrian thistle, *Onopordum illyricum,* and stemless thistle, *Onopordum acaulon,* are pasture weeds in central and southern NSW. The seed head weevil, *Larinus latus*, and the stem weevil, *Lixus cardui,* have both been released in NSW and have established in the field. NSW Agriculture and CSIRO are continuing to breed and release these weevils. The seed head fly, *Tephritis postica*, has been approved for release while another potential agent the sap sucking bug, *Tettigometra sulfurea,* is undergoing testing. Other potential agents have been studied and will be imported for testing by CSIRO.

Variegated thistle, *Silybum marianum*
Variegated thistle is a common weed on fertile soils in cropping, pasture and disturbed areas. Releases of the variegated thistle strain of the weevil *Rhinocyllus conicus* were made in Victoria during the summer of 1994/95 (Bruzzesse pers. comm).

Spear thistle, *Cirsium vulgare*
Spear thistle is a weed of cropping, pasture and disturbed areas. Releases of the spear thistle strain of the weevil, *Rhinocyllus conicus*, were made in Victoria in the summer of 1994/95, and of the seed fly, *Urophora stylata*, were made in Victoria and NSW during the summer of 1994/95 (Bruzzesse pers. comm).

Saffron thistle, *Carthamus lanatus*
Saffron thistle is one of the most widely distributed weeds in Australia. It grows in most habitats and often becomes the dominant pasture species (Auld and Medd, 1987). Some preliminary work is being carried out on saffron thistle with a view to determining whether to proceed with a biological control program (Sheppard pers. comm).

Bathurst burr, *Xanthium spinosum*
Bathurst burr is a common weed throughout NSW. A naturally occurring pathogen, *Colletotrichum orbiculare* v Arx, is being developed as a mycoherbicide for control of Bathurst burr. This is a joint project between the Sandoz Company and NSW Agriculture. CSIRO has also conducted a feasibility study into use of insects for biological control of Bathurst burr and found a number of potential agents present in Argentina.

Noogoora burr, *Xanthium occidentale*
Noogoora burr is found throughout NSW and is most common in the inland. The stem galling moth, *Epiblema strenuana*, is well established in northern NSW but does not appear to control noogoora burr. The impact of this insect is restricted because adult moths emerge in winter when there are few noogoora burr seedlings present. NSW Agriculture is looking at the use of a combination of naturally occurring pathogens for control of noogoora burr (Hosking and Holtkamp, 1993).

Boraginaceae

Paterson's Curse, *Echium plantagineum* and related species

Paterson's curse is often the dominant plant species in winter pastures of southern Australia.

A biological control program for *Echium* spp. began in 1972 (Delfosse, 1985). Echium leaf-miner, *Dialectica scalariella*, was bred and released by NSW Agriculture from 1988 until 1991 (Sullivan, Hosking and Sheppard, 1995). The moth has now established throughout the Paterson's curse areas in NSW. Two other control agents are being mass reared and released for control of *Echium* spp. They are the root weevil, *Mogulones geographicus*, and the crown weevil, *Mogulones larvatus*. These insects have the potential to cause significant damage to *Echium* spp. Breeding is being carried out by CSIRO in Canberra and by NSW Agriculture at Tamworth, Yanco and Mudgee. The crown weevil has been released at over 30 sites and appears to have established at most of these sites. The root weevil has proved difficult to rear. Council weeds officers are currently assisting with this program.

Further biological control agents for Paterson's curse are being imported into CSIRO quarantine facilities in Canberra.

Blue heliotrope, *Heliotropium amplexicaule*

Blue heliotrope is a pasture and fallow weed of the central and north western slopes of NSW.

In 1992 a feasibility study into possible biological control of blue heliotrope showed that a number of potential agents were present in Argentina.

Common heliotrope, *Heliotropium europaeum*

Common heliotrope is a pasture weed found throughout the slopes and plains areas of inland NSW.

The rust, *Uromyces heliotropii*, has been released at a number of sites in NSW and appears to cause some damage. A second pathogen, *Cercospora heliotropii-bocconii* is being tested at Canberra in quarantine by CSIRO. Trials on *Cercospora* show that this agent is highly efficient at reducing plant survival and seed number.

Clusiaceae

St John's wort, *Hypericum perforatum*

St John's wort is a weed of pastures and bushland on the tablelands and western slopes of NSW.

The defoliating beetle, *Chrysolina quadrigemina*, established in the 1940's and often produces spectacular damage, but this insect is not effective in semi timbered country (Parsons and Cuthbertson, 1992). The aphid, *Aphis chloris*, was released in 1986-87 and is now widespread throughout NSW but its effects are minimal. More than 100 releases of the mite, *Aculus hyperici*, have been made in NSW since initial releases were made in 1991. The mite has established at more than half of these sites and has caused significant damage at a number of them.

Fabaceae

Scotch broom, *Cytisus scoparius* ssp. *scoparius*
Scotch broom is a weed in bushland and pasture on the tablelands of NSW.

The twig mining moth, *Leucoptera spartifoliella*, was released in 1993 and has established at a number of sites on the tablelands. A second agent, a psyllid, *Arytainilla spartifoliella* was released in NSW during the 1994/95 summer. A seed feeding beetle, *Bruchidius villosus*, is to be released in late 1995 or in 1996.

Lamiaceae

Horehound, *Marrubium vulgare*
Horehound is a weed in conservation areas, pasture and occasionally in cropping land of the slopes and plains of NSW.

The plume moth, *Pterophorus spilodactylus*, was released in 1994 and releases are continuing. This moth defoliates plants. The clearwing moth, *Chamaesphecia mysiniformis*, is in quarantine and is awaiting permission for release. Larvae of this moth bore into plant roots. The skipper butterfly, *Carcharodus boeticus*, is another defoliator and is undergoing host specificity testing. Flower/seed feeding beetles, *Meligethes* sp., are undergoing preliminary testing in France. Studies on horehound insects are being carried out in Europe by CSIRO and in quarantine by KTRI.

Polygonaceae

Docks (*Rumex* spp.)
Clustered dock, *Rumex conglomeratus*, curled dock, *Rumex crispus*, broadleaf dock, *Rumex obtusifolius* and *Rumex pulcher* are natives of Europe and Asia while swamp dock, *Rumex brownii*, is native to Australia. Docks are weeds of cropping and pastoral lands.

The clear wing moth, *Chamaesphecia doryliformis*, was first released in NSW in 1991 (Hosking and Holtkamp, 1993) and releases are continuing. The moth appears to have established at some sites but their impact is still being assessed. Moths have been supplied by WADA.

Pontederiaceae

Water hyacinth, *Eichhornia crassipes*
Water hyacinth grows in fresh, static or slowly flowing water in tropical and temperate climatic zones (Sainty and Jacobs, 1981). It is common in coastal areas of central and northern NSW.

The moth, *Sameodes albiguttalis*, and the weevil, *Neochetina eichhorniae*, were released in the 1970's (Julien, 1992). They have both established but are not very effective in NSW. A second weevil, *Neochetina bruchi*, was first released in NSW in 1990. *Neochetina bruchi* has established and is causing considerable damage especially in warmer areas. Releases of this weevil are continuing. Two other moths, *Acigona infusella* and *Bellura densa* are being considered for introduction into Australia by CSIRO.

Rosaceae

Blackberry (*Rubus* spp.)

Blackberry is a weed of pastures and forests on the tablelands and adjoining areas of NSW. There are 8 species and 1 hybrid which are referred to as blackberry in NSW. The most common species, *Rubus discolor* (also referred to as *Rubus procerus)*, has been targeted by a strain of the rust, *Phragmidium violaceum* (Bruzzesse, 1985). This rust strain came from Europe via quarantine facilities at KTRI and was released in NSW in 1992. The rust appears to be particularly effective in areas with high summer rainfall.

Discussion

Weeds are and will continue to be the target for biological control programs.

Damage caused by agents varies across the state. Unfortunately the public often has unreal expectations of the impact of biological control. It must be remembered that biological control does not eradicate target weeds but reduces problems caused by them.

Acknowledgments

These projects would not be possible without funds provided by State and Federal authorities and various rural industry and environmental funds. In particular funding is provided by International Wool Secretariat, Meat Research Corporation, Grains Research and Development Corporation, Dairy Research and Development Corporation, Australian and New Zealand Environment and Conservation Council, NSW Environmental Trusts, Pacific Power Western and the Hunter Pastoral Company.

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MAPPING WEEDS FOR BIOLOGICAL CONTROL PROGRAMS

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Introduction

Mapping weed infestations is an important visual aid in the selection of appropriate sites and to monitor the effectiveness of weed biological control release programs by plotting the rate of spread of control agents and reduction in weed infestations. NSW Agriculture's Weed Biological Control Unit is currently using MapInfo® for this purpose.

Maps have been prepared using various mapping programs such as MapInfo® and ARMS (Automated Real time Mapping Software) for biological control programs. For example maps have been prepared for Bitou bush and Boneseed release sites (Maguire 1994).

Data Collection

A weed's infestation status must be determined before a useful map can be produced. Several techniques can be used in rating a weed. For example, Briese (1988) rated the importance of twelve thistle species in New South Wales based on the need to control them and the cost and difficulty of doing so. NSW Agriculture's Weed Biological Control Unit rates weed density in three categories - High, Medium and Low. This is quantified by estimating plants /m^2 :

Low	0 - 10 plants / 100 m^2
Medium	11 - 100 plants / 100 m^2
High	>101 plants / 100 m^2

Data is gathered using a GPS (Global Positioning System) device, herbarium records and information from weed control groups. The ideal way is for one person to rate a weed throughout the state. This way is expensive and not practicable in most cases. A more practicable way is to send questionaries to local control authorities. The major fault in this process is each officer rating a weed may have a different interpretation of the various ratings, however this may be partly overcome by adopting a rating system such as the one listed above.

All data collected is then entered into a database. The data is then sorted into the information required for mapping.

Selection of agent release sites

Data collected is matched to a local government area overlay and shaded according to the weed density rating (Fig. 1). Weed control authorities in heavily infested areas are contacted and, in conjunction with Weed Biological Control Unit officers, sites are selected. Heavy infestations are not the only criteria used in selecting release sites. Other factors such as likelihood of disturbance, other treatment methods and long term commitment of the cooperating landholder are taken into account. Sites selected as nurseries should be fenced to allow control agents to establish without interference from stock grazing or disturbing the site. For further information on release site selection see Maguire and Sullivan (1995).

Individual sites are accurately located on a map by using a GPS device (Fig. 2). A control agents rate of spread can be calculated and mapped to aid in future site selections (Fig. 3). This is useful in determining how many release sites are needed for

a control agent to cover a weeds range in a given period of time and cost associated with the program.

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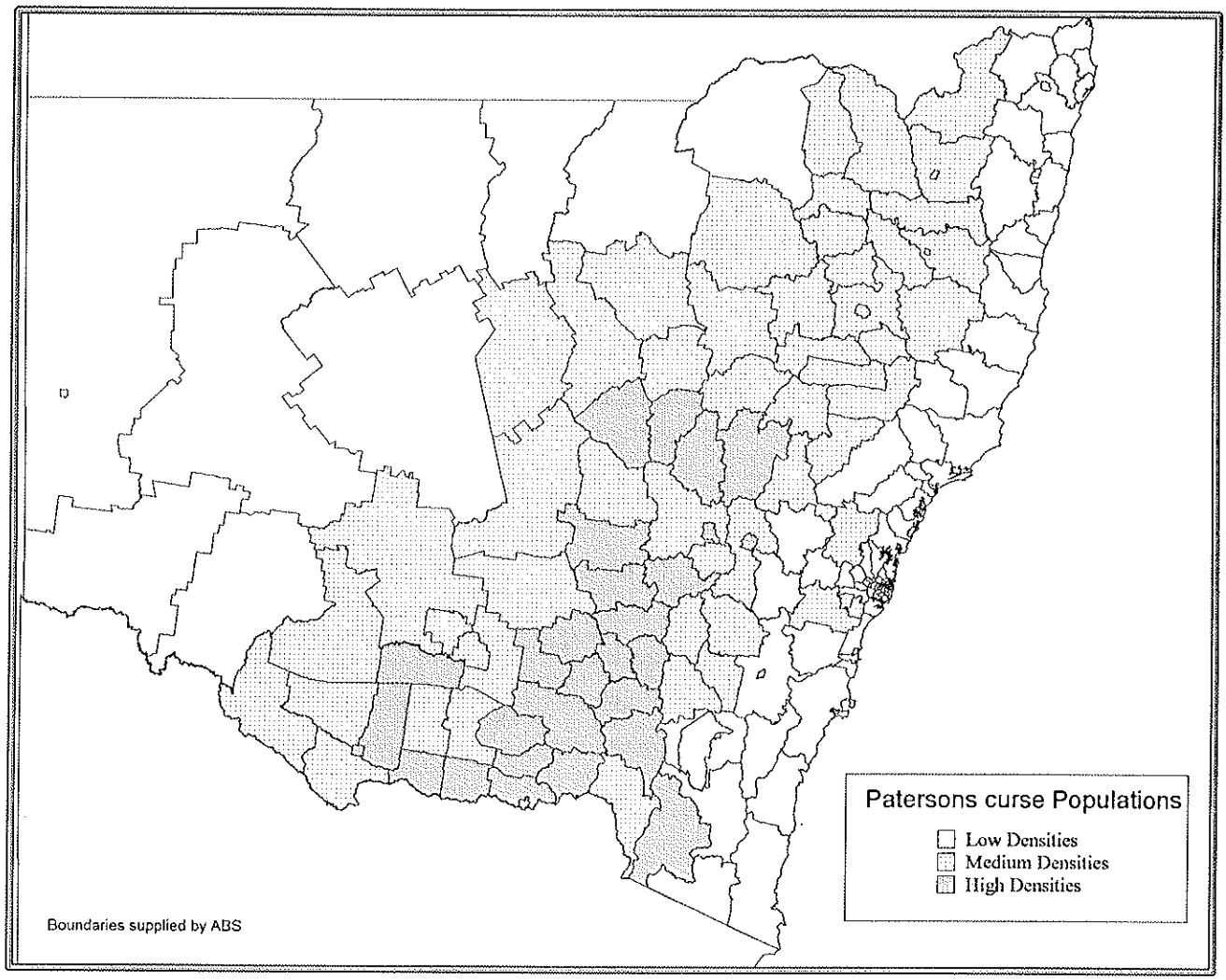
FIGURE 1



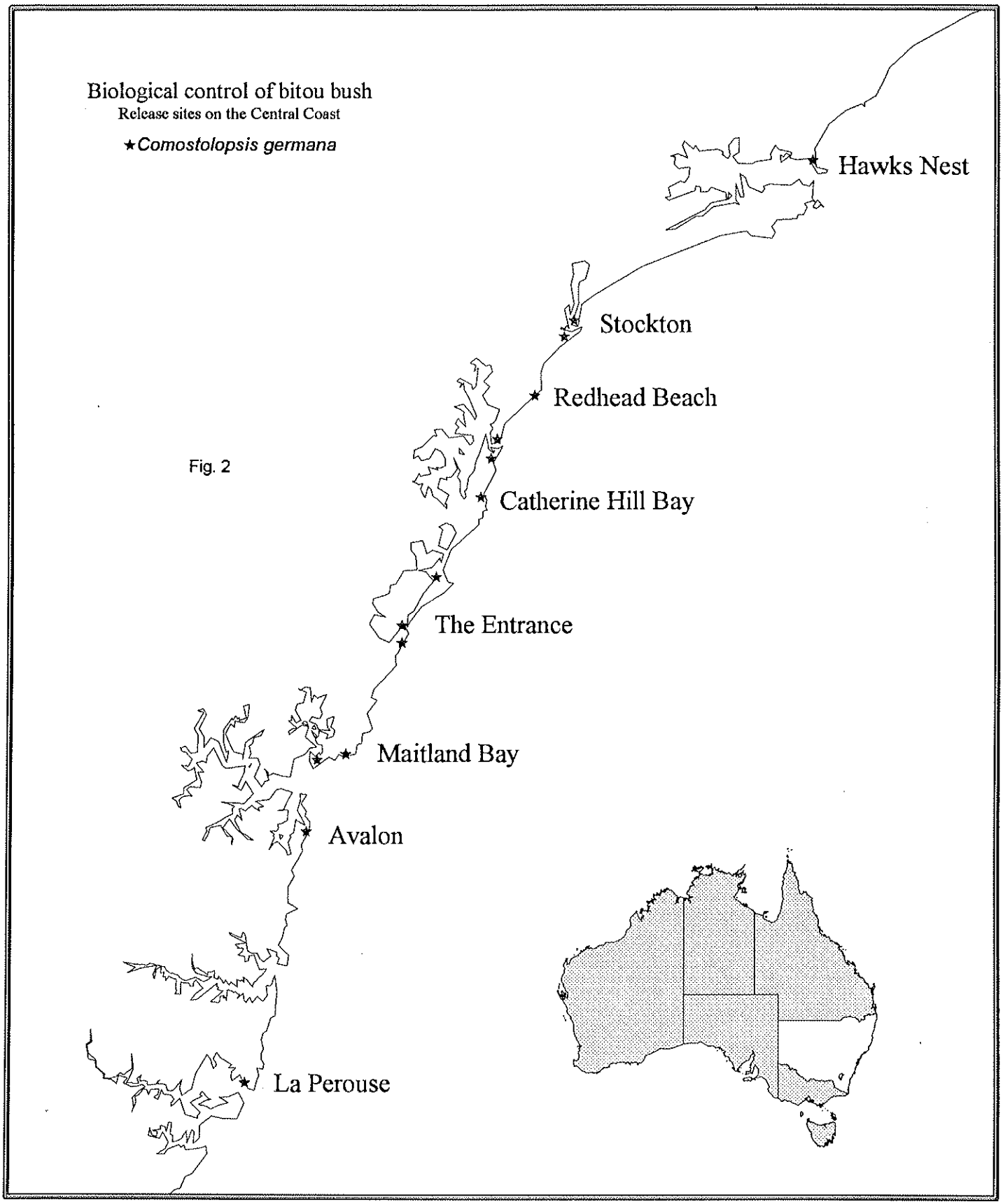

Biological control of bitou bush
Release sites on the Central Coast
★Comostolopsis germana
Hawks Nest
Stockton
Redhead Beach
Catherine Hill Bay
The Entrance
Maitland Bay
Avalon
La Perouse

Fig. 2

Potential rate of spread of a biological control agent in Snowy River Shire

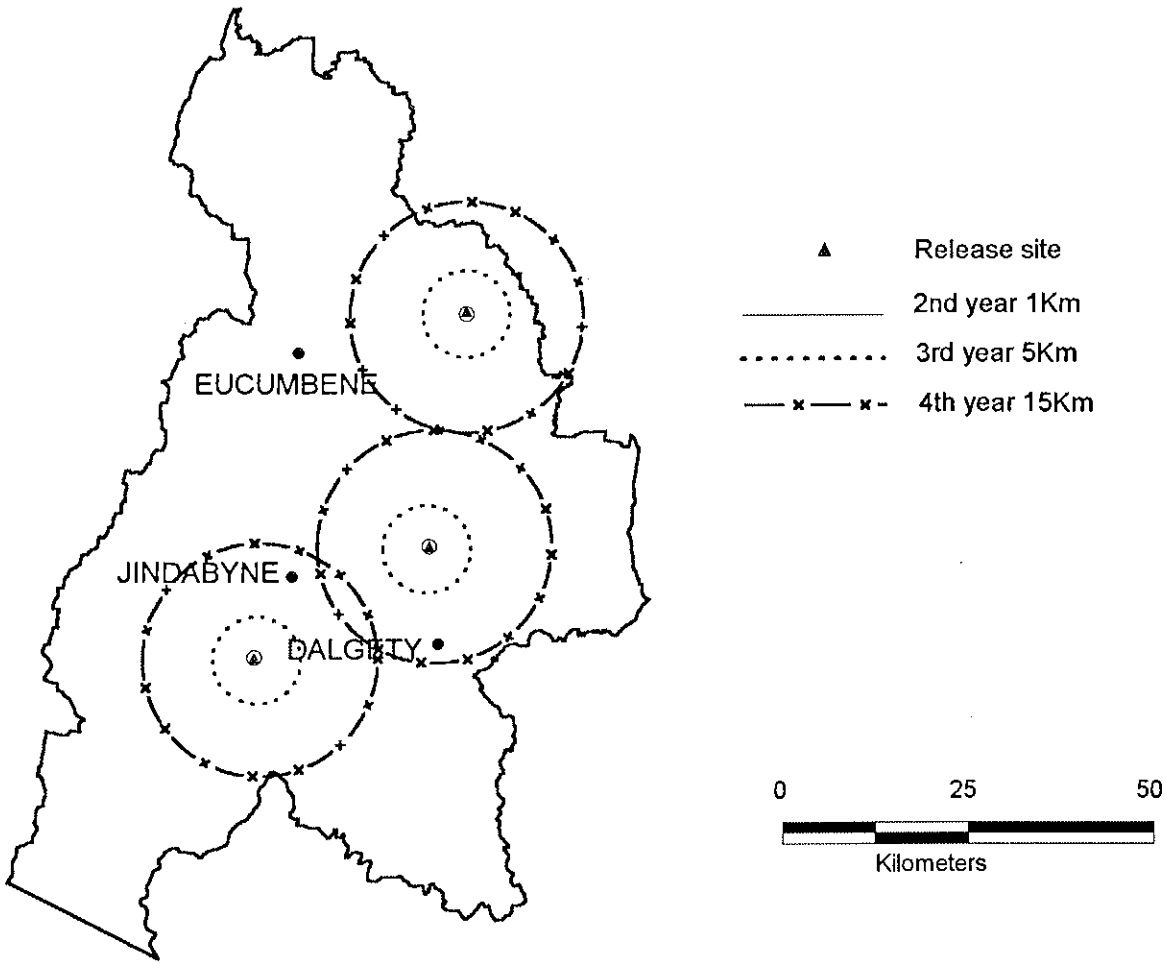


Fig. 3

ROLE OF COUNCIL WEEDS OFFICERS IN BIOLOGICAL CONTROL PROGRAMS

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Introduction

Biological control is seen by many people as an inexpensive long term environmentally friendly way of controlling weeds. Weeds officers involved in biological control programs may be seen as people who care about the environment and the financial situation of farmers and not just as a law enforcement officer.

Biological control, no matter how effective, rarely leads to eradication although it may eliminate a pest over relatively small areas for a time (Waterhouse and Norris 1987) and should be used as a tool in an integrated approach to weed control and not an excuse to cease other weed control practises.

Prior to a release of biological control agents in an area the status of the target weed must be known. Local weeds officers are the people most likely to know the current status of the target weed. Weeds officers can also aid in site selection and monitoring of biological control agents.

Determining a weeds status

Several techniques are used in determining a weeds status. Briese (1988) rated the importance of twelve thistle species in New South Wales based on the need to control them and the cost and difficulty of doing so. NSW Agriculture• s Weed Biological Control Unit uses weed density, history and habitat. Weed density is determined by quantifying plants per $m/^2$ (Maguire 1995). A weeds history in an area is required to determine if a biological control program is a priority for that area. For example a weed may be heavily infesting an area at the time a survey is carried out, but this could be due to unseasonable conditions or some other factor, though past records may show that population densities vary markedly. A weeds habitat is used to aid in agent release site selection as listed below.

Data required is usually obtained by sending questionaries to council weeds officers who use their local knowledge or past inspection reports.

Site selection

The role of weeds officers in assisting with selection of release sites for biological control agents is important to the success of the program as they have an intimate knowledge of the target weed and potential cooperators in their area. The initial costs of agent testing and releases are very high so site selection is vital. Some important factors to consider when selecting release sites:

- Determine whether the agent to be released is already present or in close proximity.
- Make certain that the target weed has been correctly identified.
- Long term commitment of the cooperator and viability of the site.
- Whether conventional control methods are economically viable.
- Sites should suit the control agent. For example the beetle, *Chrysolina quadrigemina*, used to control St John• s wort does not work in timbered areas (Parsons and Cuthbertson 1992).

NSW Agriculture

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BIOLOGICAL CONTROL SURVEY FORM

NSW Agriculture's Weed Biological Control Unit, in collaboration with CSIRO, is currently undertaking a redistribution program for control of *Echium* (Paterson's curse) species and *Carduus* (Nodding) and *Onopordum* (Scotch and Illyrian) thistles. These programs rely on the cooperation of interested groups such as Landcare and Local Government weeds officers.

If you are interested in becoming involved with any or all of the abovementioned programs, please fill in this form and return it to Paul Sullivan for the *Echium* program, or Alan Maguire for the thistle programs, at the address listed above.

Name: .....

Position: .....

Organisation: .....

Address: .....

.....

Phone: .....

Fax: .....

Please tick the box(s) you are interested in:

- ☐ **Paterson's curse**
- ☐ **Scotch and Illyrian thistles**
- ☐ **Nodding thistles**

For further information phone:

Paul Sullivan (067) 631 175 (Paterson's curse program)
Alan Maguire (067) 631 131 (Thistle programs)

These projects are funded by the Meat Research Corporation and the International Wool Secretariat

If a site is to be used as a nursery for future redistributions some other factors must be considered such as:

- Access to sites.
- Sites should be fenced to allow control agents to establish without interference from stock grazing or disturbing the site.
- Site location in relation to weed distribution - release sites should, if possible, be central to the weed infestation to make redistribution of control agents less time consuming.

Monitoring release sites

Monitoring of release sites is essential to ensure the control agent is establishing and to see what effect the agent is having on the target weed• s population. A weeds officer can monitor release sites effectively with a little training. Basic things to look for when monitoring a site are:

- Abundance of control agents, or evidence of their damage.
- Rate of spread of control agent from initial release site.
- Amount of damage to target weed caused by control agent.
- Reduction or otherwise in population of the target weed.

For more information on monitoring techniques and biological control of weeds in general see Harley and Forno (1992)

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-ooOoo-

SAVING WETLANDS FROM WEED INVASION

Geoff Sainty
Sainty and Associates

The best way to combat weeds is to prevent them from invading. To do this successfully requires a knowledge of weeds likely to invade the wetland (refer to list). Even more important is (I) information about the wetlands catchment, (ii) its contamination from development and, (iii) the use to which it is being put.

Wetlands are remarkably resilient, but even the best cannot withstand the buffeting they sometimes receive.

Take for example the Botany Wetlands. This 30 hectare wetland comprises a series of ponds receiving water from the aquifer draining into it, and run-off from some of the most densely populated urban land in Australia. The Botany Wetlands were once used for water supply and swimming. The area is now unfit for any active use and the sediments contain large quantities of contaminants including toxic heavy metals, some of which have leaked into the area from a now disused garbage depot landfill.

The Botany Wetlands have been invaded by introduced weeds. Notable waterweeds include Water Hyacinth, Salvinia, Alligator weed, *Ludwigia peruviana*, *Cabomba caroliniana*, *Myriophyllum aquaticum*, *Nymphaea mexicana* and *Egeria densa*.

The edges of the ponds are infested with Pampas Grass, Crofton Weed, Hydrocotyle, Blackberry, Privet, Willows, Coral Tree and Green Cestrum. There are over 100 species of introduced weeds along the margin of the ponds and most of the native species have disappeared. European Carp disturb the sediments and blue-green algal blooms are common place.

So what has caused this massive invasion of exotic plants in the Botany Wetlands?

Firstly, the seeds or propagules of the waterplants have been unwittingly introduced to the area when the contents of aquaria have been tipped into the water. Centennial Park ponds drain into the Botany Wetlands and many of the weeds come from this source.

Secondly, the sediments and the water are enriched from all the activity upstream, including Randwick Racecourse. In these nutrient-enriched conditions the introduced species have a competitive advantage over the native species

Thirdly, the wetlands have been neglected and there has been no management plan in operation to help limit or prevent the first two causes, or to modify the effects produced by these causes.

Compare Botany Wetlands with "Y" Swamp on the south coast near Moruya.

This wetland of about 15 hectares is surrounded by natural healthy coastal forest and has a high conservation value. It is relatively untouched and contains more than 20 species of native plants plus the noxious waterplant *Salvinia molesta*.

Horse and car racing tracks are in the catchment, but urban, industrial and agricultural run-off into the wetland is minimal.

Judging by the health of the waterplants and presence of some insectivorous species (*Aldrovanda* and *Utricularia*) nutrient levels are low and Salvinia is not thriving there. The cool south coast winters probably give an advantage to the native waterplants over the more tropical Salvinia.

Eradication of Salvinia is unlikely from "Y" Swamp. The infestation is too large and dispersed through the emergent sedges. However, if Salvinia had been detected sooner, its eradication may have been possible.

In this case preventing enrichment of the system, so that the nutrients do not favour Salvinia, is possibly the only environmentally prudent approach that can be taken now. Biocontrol of the Salvinia has doubtful potential but should be attempted.

Finally, the best defence against the invasion of some weeds is through competition. For example, tall dense Cumbungi or Phragmites will crowd out many smaller waterplants. If the density of the desirable plants is sufficiently high few undesirable plant species will survive.

Major and potential waterweeds in Australia

WEED SPECIES	LIFE FORM emergent submerged floating	ANNUAL PERENNIAL spreads by:	NOXIOUS national, local	IMPORT-ANCE potential: minor, serious very serious	WHERE: CONTROLLED BY:
*Alisma lanceolatum	emergent	perennial, pieces, seeds	noxious, local	serious	rice, herbicides
ALLIGATOR WEED *Alternanthera philoxeroides	emergent, floating	perennial, pieces	noxious, national, local	very serious	wetlands, herbicides
CABOMBA *Cabomba caroliniana	submerged	perennial, pieces,seeds?	noxious, local	serious	wetlands, herbicides, (out of control)
BARNYARD GRASS *Echinochloa crus-galli	emergent	annual, seeds	–	serious in rice minor elsewhere	rice, herbicides, water level
DENSE WATERWEED *Egeria densa	submerged	perennial, pieces	–	minor	rivers, wetlands, no control
WATER HYACINTH *Eichhornia crassipes	floating	perennial, seeds, offsets	noxious, national	serious	wetlands, herbicide, mechanical, water management, biocontrol
ELODEA *Elodea canadensis	submerged	perennial, pieces	–	serious in channels	channels, herbicides
SENEGAL TEA *Gymnocoronis spilanthoides	emergent	perennial, seeds	noxious, local	serious	wetlands, creeks, herbicides
REED SWEETGRASS *Glyceria maxima	emergent	perennial, pieces, seeds	noxious, Tasmania	minor	wetlands, channels, herbicides
HYDROCOTYLE *Hydrocotyle ranunculoides	emergent, floating	perennial, pieces, seeds	noxious, Western Australia	serious	creeks, herbicides, mechanical
ASIAN WISTERIA *Hygrophila difformis	emergent	perennial	–	potential	wetlands
*Isolepis prolifera	emergent	perennial, offsets, seeds	–	minor	wetlands, herbicides, manual

WEED SPECIES	LIFE FORM emergent submerged floating	ANNUAL PERENNIAL spreads by:	NOXIOUS national, local	IMPORT-ANCE potential: minor, serious very serious	WHERE: CONTROLLED BY:
SPINY RUSH *Juncus acutus	emergent	perennial, seeds	noxious, local	serious	wetlands, herbicides, mechanical
JOINTED RUSH *Juncus articulatus	emergent	perennial, pieces, seeds	–	minor	wetlands, channels, creeks, mechanical, herbicides
LAGAROSIPHON *Lagarosiphon major	submerged	perennial, pieces	noxious, national	potential	deep storages, no control
WILLOW PRIMROSE *Ludwigia peruviana	emergent	perennial, seeds, pieces	noxious, local	very serious	wetlands, herbicides, manual, mechanical
PENNYROYAL *Mentha pulegium	emergent	perennial, seeds, pieces	noxious, Western Australia	serious	wetlands, channels, herbicides, mechanical
PARROTS FEATHER *Myriophyllum aquaticum	emergent	perennial, pieces, no seeds	noxious, local	minor	wetlands, channels, herbicides, mechanical
WATER LETTUCE Pistia stratiotes	free floating	perennial, pieces, seeds?	noxious, local	minor	wetlands, rivers, herbicides, mechanical
YELLOW WATERLILY *Nymphaea mexicana	floating attached	perennial, rhizomes	noxious, local, Qld	serious	wetlands. herbicides, mechanical
CREEPING BUTTERCUP *Ranunculus repens	emergent	perennial, pieces, seeds?	–	minor	wetlands, herbicides, mechanical
CELERY BUTTERCUP *Ranunculus sceleratus	emergent	annual, seeds	–	minor	wetlands, channels, herbicides
WATERCRESS *Rorippa nasturtium-aquaticum	emergent	perennial, seeds	–	minor	wetlands, creeks, drains, herbicides, mechanical
*Rotala rotundifolia	emergent	seed, pieces	–	potential	wetlands herbicides, manual
WILLOWS *Salix spp.	tree, shrub	pieces, seeds	–	serious	rivers, creeks, wetlands, mechanical, herbicides
SALVINIA *Salvinia molesta	free floating	perennial, pieces	noxious, national	very serious	rivers, creeks, wetlands, biocontrol, herbicides, mechanical, drying
SAGITTARIA *Sagittaria graminea	emergent	perennial, pieces, seeds	noxious, local	serious	channels, wetlands, creeks, herbicides
ARROWHEAD *Sagittaria montevidensis	emergent	perennial, annual, seeds	–	minor	rice, wetlands, creeks, herbicides, mechanical
*Schoenoplectus californicus	emergent	perennial, not known	new waterplant in Australia	not known	Williams River, NSW
CUMBUNGI Typha spp. *Typha latifolia	emergent	perennial, seeds	noxious, local	minor serious	rice, wetlands, channels, herbicides, mechanical, manual

GROUNDSEL BUSH MANAGEMENT PLAN

Jeff Thomas
Pest Species Management Officer
NSW National Parks and Wildlife Service

Introduction

Groundsel Bush (*Baccharis halimifolia*) is a declared noxious weed under the Noxious Weeds Act 1993. Its status, under the Noxious Weeds Act, is as a category "W2" noxious weed. This classifies it as weed which poses a threat to agriculture, the environment or the community and where infestations are known to occur must be suppressed and destroyed.

The National Parks and Wildlife Service undertakes control for two reasons:

1. To meet its obligations under the Noxious Weeds Act to prevent the spread of groundsel bush onto neighbour's land.

2. To protect the natural environment by preventing this weed altering natural habitats and displacing flora and fauna.

Groundsel bush prefers disturbed habitats resulting from abandoned land development, sandmining, canefarming and other agricultural practices. It also invades undisturbed coastal swamp forests and saltmarsh. It is commonly seen as a medium to tall shrub growing under forests dominated by broad-leaved paperbarks (*Melaleuca quinquinervia*) and swamp oak (*Casuarina glauca*).

Infestations are more common along lower estuarine areas within Yuraygir and Bundjalung National Parks and the heaviest infestations have occurred on old canefarming and grazing land within the park. The infestation of groundsel bush in Yuraygir and southern Bundjalung National Parks largely pre-dates National Park reservation. Infestations also occur on nearby forest, Crown land and adjoining private property.

Planning

In the 1980's following reservation of these two parks the Service commenced control programs. Initial control programs were sporadic and concentrated on small heavily infested areas, often in response to neighbour concerns.

During the 1990's the Service secured additional funds from a variety of sources for this program. This has included the Contract Employment Program for Aboriginals in Natural and Cultural Resource Management.(CEPANCRM), the NSW Government's Noxious Weeds Fund and recently, increased internal funding specifically for weed control.

From this we embarked on an expanded control program. The first stage of this program was to develop, in consultation with NSW Agriculture and Maclean Council, a 5 year strategic plan.

This plan describes, in detail, the nature and extent of infestation, previous control programs and a year by year assessment of control with regard to requirements for funding, areas to treat, equipment and labour required.

The first step in this plan was to accurately map the distribution of groundsel bush throughout both parks. This revealed a more extensive infestation than previously thought, with infestations in virtually all suitable habitats many of which were in inaccessible areas. Infestations were classified as low, medium and high, mapped onto 1:25000 topographic maps and then digitised using the Service's GIS (Geographic Information System). This allows for easy presentation of information, calculation of areas infested and treated and a predictive capacity when combined with other information types within the system.

The control program has the following objectives:

1. Eliminate groundsel bush from areas adjacent to all boundaries in Yuraygir National Park and the lower Esk River area of Bundjalung National Park.

2. Eliminate readily accessible isolated populations of groundsel bush in Yuraygir and Bundjalung National Parks.

3. Prevent re-infestation of treated areas.

4. Eliminate or significantly reduce populations where they occur adjacent to roads and vehicle access tracks.

5. Eliminate remaining infestations in Yuraygir and Bundjalung National Park

6. Monitor the distribution of groundsel bush and review the impact of control.

7. Undertake control measures to comply with the National Parks and Wildlife Act, the Pesticides Act, the Noxious Weeds Act and the Occupational Health and Safety Act.

8. Liaise with government departments, local control authorities and neighbours to ensure a co-ordinated approach is undertaken in the area.

While the objective to "eliminate" may be questioned in many situations as being realistically achievable it was felt useful as it keeps a strong focus on the presence of this noxious weed.

The areas to be treated and the resources required (physical, labour and financial) required for each year were spelt out in the plan.

Implementation

The program adopted an integrated approach involving physical removal, herbicide application and the use of biological agents.

Herbicide application is by the far the most widespread control method.. The Service purchased two new 'Quik Spray' units, one a large 600L unit with twin hose reels for a vehicle and a smaller 200L customised unit primarily for boat based work but also capable of removal for use on a vehicle. A boat was also purchased to reach the otherwise inaccessible infestations along the lower estuaries.

The program has been carried out by using temporary NPWS field staff(with occasional assistance from permanent staff) and contractors. Private contractors have included vehicle based control as well as aerial helicopter application in some heavily infested areas . Wherever possible the program has been done in collaboration with adjoining councils, and Service neighbours.

The Service is participating in a co-operative program for the use of biological control agents as a control measure against groundsel bush Two species of insect have been released in the Parks: a gall fly (*Rhopallomyia californica*) and a stem boring moth larvae (*Oidaematophonus ballanotes*).

Released over ten years ago, the gall fly has spread extensively and can be seen throughout both Parks However it has had only minimal effect. First released in March 1992, the stem boring moth larvae has shown potential to become a successful biological control in swampy, saline areas. It is spreading into suitable habitats throughout the park and is beginning to cause significant but localised damage.

The Service will continue to monitor these programs and liaise with local government, New South Wales Agriculture and Queensland Department of Lands.

Results

The area of park treated each year from 1987 to 1994 is shown below.

Season	Area (ha)
1986/87	102
1987/88	134
1988/89	0
1989/90	0
1990/91	103
1990/91	80
1992/93	327
1993/94	676

The area treated in 1994/95 season will be similar to that treated in 1993/94. Of the 1480 ha of land mapped as infested with groundsel in 1994 at least 70 % has now treated. All boundary areas have been treated at least once, and 80% of the 248ha classed as heavy infestation in 1994 has been treated. Small isolated infestations have been eliminated or significantly reduced. The control program is ahead of schedule, especially with initial treatment of infestations. However, most areas have required follow-up treatments to prevent re-infestation from seed reserves in the soil..

Conclusion

The additional funding available in recent years has allowed the groundsel bush control program in Grafton District to be expanded.

This has enabled the extent and severity of the infestations to be accurately mapped, a control program to be developed and resourced and the treated areas to be updated continually. This has resulted in a very effective program which has significantly reduced the area infested with groundsel bush.

STREAMBANK WEEDS

Geoff Sainty
Sainty and Associates

Controlling streambank weeds presents a dilemma. On the one hand exotic plants such as Willows, Honey Locust, Camphor Laurel, Privet, Rubber Vine, Tamarisk and Blackberry are undesirable or noxious. These species can dominate streambanks and crowd out desirable riparian species that are often more valuable habitat for large animals and invertebrates. On the other hand these introduced trees and shrubs prevent streambank erosion and are often sufficiently dense to restrict stock access.

Wholesale removal of streambank weeds may have serious erosion consequences. Thus any control program must first have in place a replacement vegetation strategy. Small scale selective removal of trees or shrubs will probably have little impact on the stream.

One method of replacing exotic plants with native vegetation is to fence off the area and commence a planting program that is planned to extend for many years.

There is an example of this method on the Nambucca River in northern NSW. The Willow *Salix nigra* was planted on an eroding stretch of the River about 10 years ago. Stock were excluded from the planted area so that the Willows could grow. The fence has been maintained until now and already Sandpaper Fig, Bottlebrush, River Oak and other native shrubs have invaded the area. Ultimately the Willows can be safely removed.

Willows have recently come under close scrutiny. Some stream managers believe Willows are mostly useful and the only tool to stop serious streambank erosion. They are prepared to countenance further introductions!. Some stream managers believe all Willows are harmful and advocate their total removal. In the last few years it has been discovered that there at least 15 "species" in Australia. And contrary to previous knowledge that they do not produce fertile seeds, in fact seedlings have been recorded from all but one species.

At present we are not even sure what species of Willows are naturalized, or even if "species" is the best word to use. Some effort is now being put into understanding the species that are here, and this should become clearer over the next few years. In the meantime, new plantings should not take place unless it is certain that viable seeds will not be produced. Ultimately, methods of establishing suitable native vegetation will be developed.

Camphor Laurel, native of China, is now widespread and common especially along the north coast of NSW and the south east coast of Queensland. In some areas much of the stream is dominated by Camphor Laurel. This tree will develop a dense canopy over the water, shading out most bank and submerged plants. Camphor from the leaves, twigs and fruit has an unknown but potentially toxic effect on invertebrates, crustaceans and fish.

Camphor Laurel produces a useful timber. This resource is currently mostly wasted.

Honey Locust *Gleditsia tricanthos*, native of N. America, is a very thorny leguminous deciduous tree to 20 m tall that can form dense thickets, crowding out riparian and

floodplain vegetation. A prolific seeder, it is now steadily expanding in numbers across eastern Australia. The Hawkesbury-Nepean Valley in NSW is now widely infested from an original planting by Macarthur at Camden Park in the 1860's. Early action is desirable to control small populations before they expand.

Cockspur Coral Tree *Erythrina crista-galli*, native of S. America, is another thorny leguminous tree showing potential to expand along streams. Part of a creek at Elanora Heights near Sydney is now choked with this tree.

In Central Australia Tamarisk *Tamarix aphylla* has invaded ephemeral streams, such as the Finke River, displacing River Red Gums. In this remote situation mechanical and chemical control is expensive, and hundreds of kilometres of streams have been infested.

Blackberry *Rubus discolor* has for a long time been problem along streams. Control using herbicides is restricted because of the potential to contaminate the stream. Biocontrol with Blackberry Rust *Phragmidium violaceum* has the potential to reduce the size of the problem.

Stream bank weeds are best managed by the following methods:

1. Early identification and removal.
2. Herbicides and mechanical methods.
3. Biocontrol agents where applicable.
4. Replacement vegetation strategy.
5. Fencing to exclude or include stock.
6. Utilisation where appropriate.

Management plans should be prepared on a single catchment basis. Extrapolating many 100's of kilometres from one catchment to another is unlikely to be useful; it could even exacerbate problems.

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ALLIGATOR WEED - MIA CAMPAIGN
Has it Been A Success?

Hugh Milvain
Noxious Plants Advisory Officer
NSW Agriculture, Yanco

Background

Alligator Weed (*alternathera philoxeroides*), a native of South America was first recorded in New South Wales during the early 1940s at Newcastle. It now causes serious problems in waterways throughout the tropical and warm temperate regions of the world.

In New South Wales since the 1940s it has colonised along the coastal areas from Sydney north to Raymond Terrace. In the early 1970s an area was identified at Woomargama in Southern New South Wales just north of Albury and more recently in the 1990s at Canberra on Lake Ginninderra and the Murrumbidgee Irrigation Areas west of Griffith.

The MIA

During December 1993 and January 1994 a plant mass growing in supply channels was causing major problems to water distribution to irrigators in the Wah Wah Irrigation District west of Griffith and by February flows in a supply were reduced to a point where little or no water was being received at the end of the system. Plant samples were collected and taken to CSIRO Griffith for identification, with the identification being given to Pat Spence, Weed Control Manager of the Department of Water Resources on 16 February.

Inspection of the infestations were made on 17 February in the Wah Wah main, Barren Box Outfall and Corgenia Channels. These areas varied in size from 2-10 square metres in the channels, effectively reducing the waterflow by a minimum of fifty per cent.

A control plan was formulated in association with CSIRO Water Resources and NSW Agriculture. Water movement from the swamp for irrigation use was prohibited as a means of reducing the movement of plant fragments further afield.

Spraying commenced about the end of February 1994 of those sites in the channel system downstream of the swamp. As a safeguard to the irrigators and when all systems had been treated, treatment of the swamp was commenced.

Equipment used was truck mounted sprayers with a bucket arm which allowed the operator to be positioned out over the rafts in the channels and to spray toward the channel bank.

At the same time all DWR water distribution officers were briefed on the identification of the plants and asked that when working their sections to watch out for any unknown areas of infestation and to report the location to Pat Spence who would arrange for treatment to be carried out.

By mid-March, the extent of the area involved was becoming clear with approximately 40 kms of channels west of Barren Box Swamp and a substantial area of the swamp's perimeter being affected including the Mirrool Creek bywash downstream of Willow Dam.

Also by this time, terrestial infestations were being reported - one on a property adjoining the swamp which had used soil from the swamp to fill 500 metres of channel and the end result was 500 metres of Alligator Weed, and one of approximately 10 square metres in a rice crop at a point where water first entered the crop.

Control on the swamp was proving to be a problem with the available equipment only being able to treat a narrow strip along the bank edge or the inside edge from the water.

At this stage, after lengthy discussion, an air boat and a helicopter were engaged to spray the swamp and an excavator was deployed to remove the dying plant mass from the channel systems.

The chemicals used were Glyphosate on all areas deemed aquatic, Metsulfuron on the terrestial areas and Dichlobenil in areas which had terrestial plants in shallow ponded water. The Dichlobenil was only used in select areas on a limited basis.

A Task Force was established to co-ordinate the control program. It was through the Task Force that closures of the Barren Box Swamp were implemented. The closures of the swamp for the Duck Season and fishing were for a 12 month period but this was extended until March 1996 at which time it will be reviewed.

The co-operation from landholders and government agencies was very good, as the landholders in particular wish to maintain a good supply of irrigation water.

Most of the irrigators placed screens in front of their water wheels to catch any fragmented pieces of Alligator Weed that may have escaped detection in the channel screens.

Water Resources put a boat and two-man crew into the channel system to physically remove any plant fragments, with this operation being completed by the end of July 1994.

Spraying recommenced in December 1994 and was completed in June 1995 with a total of 5 treatments applied plus a boat patrol of the channel systems.

This 1994/95 program was centred on the swamp which had a heavy draw down of the stored water which in turn allowed for the bed to become trafficable.

During the same period, additional on-farm findings occurred including a second rice crop.

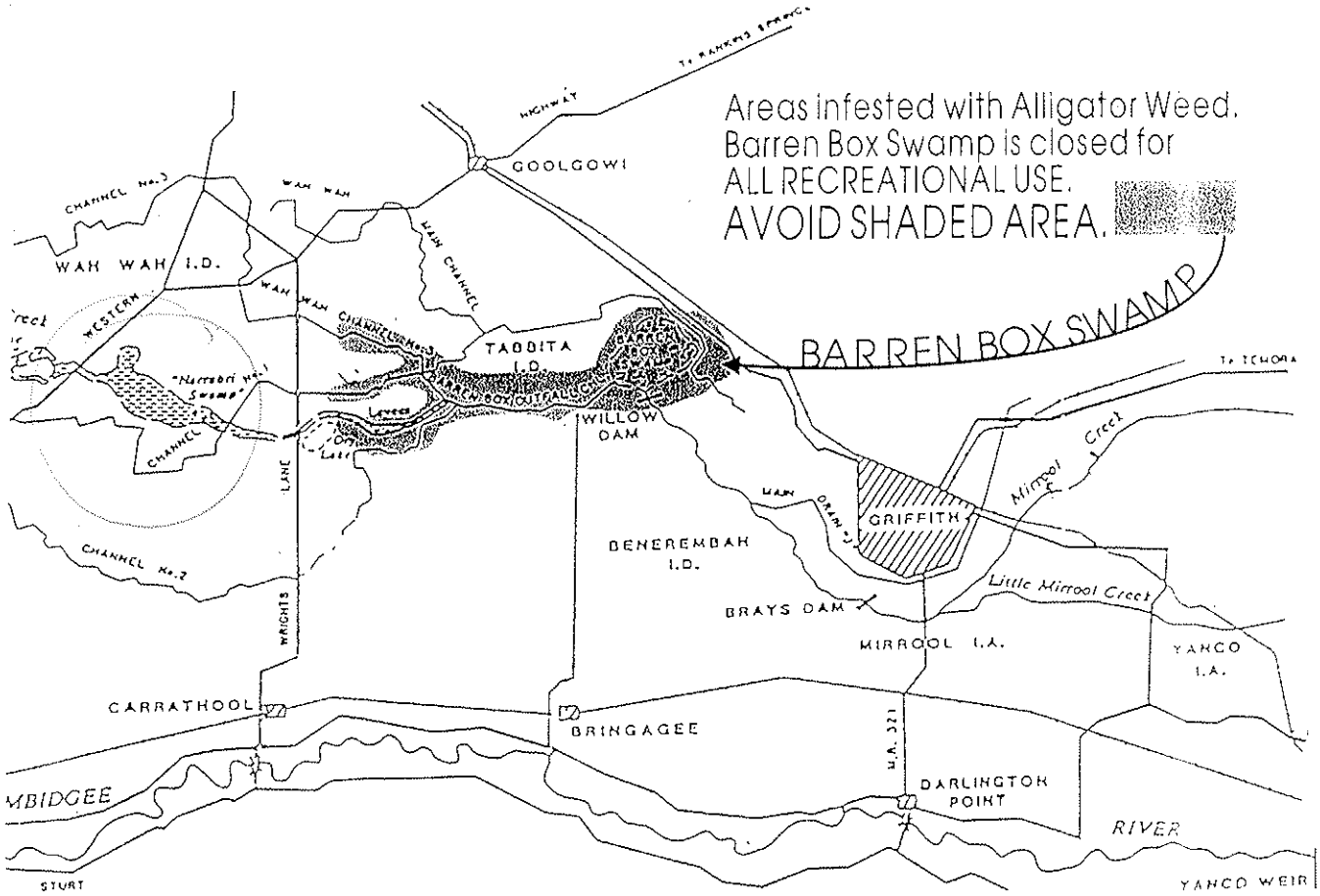
In Summary

Overall, the two seasons of control have been able to reduce the incidence of Alligator Weed in the MIA and prevent the spread further afield than the area to that which it was confined to.

The problem area which still exists is the Mirrool Creek floodway. This area was treated to the level of remainder of the system because of the drought and the high stocking rate of Emus, Kangaroos, cattle and sheep who had a race to see who could get to anything that grew first. This particular section will have a stock enclosure placed on it so as to allow growth of Alligator Weed to take place for effective treatment.

In ending I would say that, Yes, control of alligator Weed in the MIA has been a success even though the overall cost for the two seasons has been approximately $600,000.

MAP



Appear to have been past back to 1991

PARTHENIUM WEED ALERT

Peter Gray
Noxious Plants Advisory Officer
NSW Agriculture

This coming summer (1995-96) will provide noxious weed control authorities and landholders throughout NSW with the biggest threat of the parthenium weed yet experienced in this State.

Parthenium weed, which is a very serious noxious weed in Queensland, has been causing great concern in NSW since the late 1970's. Due to a concerted effort by all concerned this weed has not, to the best of our knowledge, been allowed to become established in NSW. However this coming season could well be the most critical season yet.

While the drought conditions in recent seasons have caused a significant reduction in the movement of harvesting equipment between NSW and Queensland, they have also contributed to a significant increase in the movement of stock fodder.

It is this stock fodder movement, particularly in the form of sunflower hulls, that has led to the greatly increased risk of parthenium weed infestations occurring during this coming season. The extensive sale of these sunflower hulls means that there could be infestations anywhere in the State.

It is virtually impossible to control parthenium weed in sunflower crops so any sunflower seed produced in parthenium weed areas in Queensland is almost certain to be contaminated with parthenium weed.

During April 1995 a farmer at Moree found 13 parthenium weed plants growing on the edge of sunflower hulls which had been dumped in an open fronted shed and were spilling out into the open. It is very fortunate that he had recently attended a roadside field day on the identification of parthenium weed otherwise he may not have recognised the plants.

Subsequent investigations established that the crushing plant in northern NSW from which he had obtained these hulls had recently crushed 75 tonnes of sunflower seed of which 25 tonnes came from Clermont in central Queensland, the home of parthenium weed. The sunflower hulls, which were the residue from the crushing process to extract the oil, were then sold as stock fodder which was then widely distributed in NSW. It is estimated that the total quantity of these sunflower hulls that could be contaminated was 3,750 tonnes.

The Department has obtained details as to the distribution of this material and the known deliveries have been notified to the relevant weeds inspectors however there are undoubtably some properties that have not been identified. The known sites will have to be closely monitored and all weeds inspectors will have to be extremely vigilant in regard to any unidentified sites that may be in their area.

Samples of the hulls were collected from many of the locations and sent to the Department's seeds laboratory for analysis. Parthenium weed was not found in many of these samples however given the quantity of individual sunflower hull deliveries and the relatively small quantity that could be analysed, this could not be taken as

conclusive proof of cleanliness. However positive results were obtained from several sites in northern NSW including the previously mentioned property. The sunflower hulls from this property were subsequently collected by the crushing plant and returned to Queensland.

Another infestation of parthenium weed was discovered at Tenterfield in the northern New England Tablelands in June. This infestation of 12 plants was growing in a paddock amongst pasture. It is believed that this infestation came in a formulated feedlot ration from Queensland.

Since the last biennial conference in 1993 there has been a major infestation of parthenium weed discovered in a cultivation paddock at Condobolin in the geographic centre of NSW. In addition, there have been several roadside infestations of which at least two have been undetected for two seasons as well as other infestations such as in an urban houseyard, farm paddocks and a machinery dealers yard.

The Condobolin infestation illustrates that parthenium weed is potentially a problem in central and southern NSW and cannot be dismissed as a problem threatening only northern NSW. In addition it, and some of the other infestations that remained undetected for at least 12 months, demonstrated the problem of many people not being able to readily recognise this most serious noxious weed.

The infestation at Condobolin, which is believed to have been caused by harvesting operations in 1992, remained undetected for 16 months during which time many plants had seeded down and second generation plants were also seeding down.

The infestation was in a back paddock of the property concerned and the area had not been cropped since the harvesting in 1992. There are reports of neighbours driving on the road outside the paddock wondering as to the identity of the green weeds growing in the paddock during the very dry conditions and not being eaten by the stock.

The bulk of the plants occurred over an area of 80 hectares with isolated plants further afield. The larger patches were sprayed with dicamba immediately and then several weeks later with diesel and burnt. The smaller patches/single plants were marked with a stake before the plants were pulled, bagged and then burnt at a central point. The number of plants pulled was in the order of 800. The sites from which these plants were removed were then sprayed with atrazine for residual control.

The community of the Condobolin district has recognised the threat that this parthenium weed infestation poses to the district and has got right behind the efforts to eradicate this infestation and to stop it spreading further afield. A Parthenium Weed Eradication Group in Lachlan Shire was formed at a public meeting organised by the Shire Council. Almost 100 members of the public have volunteered to join weed walk groups to undertake systematic inspections of the paddock on a revolving basis.

Due to the dry conditions there had been limited germinations of the weed until the autumn of 1995 and the planned application of atrazine for last season was postponed. The area was cultivated in the autumn of 1995 following this germination of parthenium weed. The seedlings from a subsequent germination survived the very cold winter conditions and were sprayed in August 1995 (1L Wipe Out® + 500 mL 2,4-D ester 800 per hectare).

the atrazine is to be applied in the spring when conditions warm up, providing there is sufficient moisture.

Parthenium weed can enter NSW in many different ways and during this coming season it will require, more than ever, vigilance and a concerted effort by all concerned to keep this menace from becoming established in NSW. The importance of preventing the establishment of this very serious noxious weed in NSW cannot be over emphasised.

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Information brochures and videos on parthenium weed are available on request from:
Program Leader (Weeds), NSW Agriculture,
Locked Bag 21, Orange, 2800.

HERBICIDE RESISTANCE
WHICH HERBICIDE GROUP?

J J Dellow
Weeds Agronomist
NSW Agriculture
Orange

By the end of 1995 all herbicide labels will be required to have the *"Herbicide Group"* printed on the cover section of the label. The *Herbicide Group* is particularly important in regard to herbicide resistance of weeds.

Herbicides have differing modes of action and the grouping is based on these modes of action. There are 13 separate groups and all herbicides having the same or similar mode of action are group together. The 13 groups are listed alphabetically from A to M.

The herbicide groupings is part of the herbicide resistance awareness campaign aimed at avoiding or overcoming the problem of herbicide resistant weeds.

As most farmers are aware, herbicide resistant weeds are a major cropping problem; particularly in the southern wheat belt. In the eastern portion of the southern wheat belt, in some areas there are as many as one in two paddocks having herbicide resistant weeds - in particular annual ryegrass. Other herbicide resistant weeds include wild oats, Indian hedge mustard, wild turnip, annual bindweed, capeweed and common sow thistle.

What is herbicide resistance?
Herbicide resistance is the ability of a weed to survive a herbicide rate that would normally control it. Weeds become resistant by repeated use of the one herbicide or other herbicides with a very similar mode of action. The repeated herbicide applications remove susceptible plants allowing the naturally resistant weeds to survive and eventually dominate, producing a resistant population.

There are high and low risk herbicides. The more selective the herbicide, the greater the risk of weeds becoming resistant.

What To Do
An important part of an overall integrated strategy is to avoid the continual and repeated use of herbicides from the same group. Herbicides should be rotated between groups. It is important to make every herbicide application count. Use the application rate which gives the best kill for your situation.

The continued reliance on *highly selective* herbicide particularly in the high risk Group A and Group B is a recipe for quick herbicide resistance.

The 13 herbicide groups (A to M) are grouped in three risk categories.

High risk	Group A and B
Moderate risk	Group C to H
Low risk	Group I to M

The high risk groups A and B contain the majority of the selective post emergent, annual grass killing herbicides such as Hoegrass® and Fusilade® (Group A) and Glean®, Ally® and Broadstrike (Group B).

Luckily, the phenoxy (hormone) herbicides such as 2,4-D and MCPA (Group I) are low risk due to their broad mode of action.

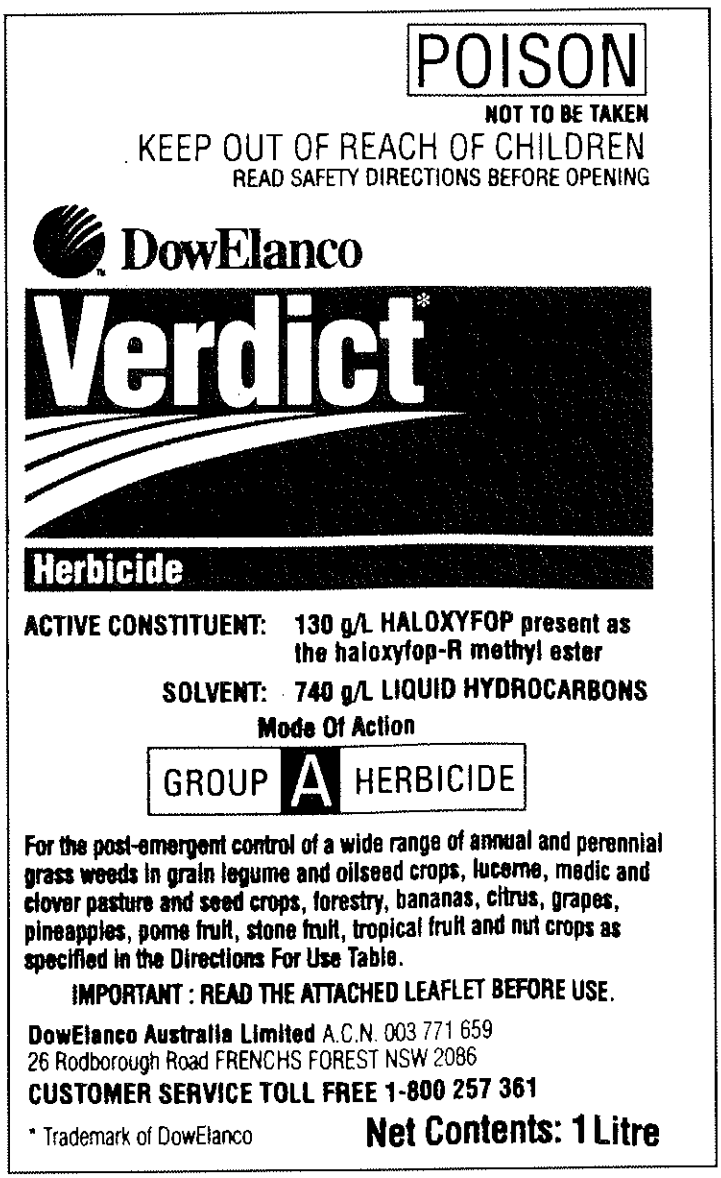
Also the knockdown herbicide such as Gramoxone®, Glyphosate® and Touchdown® (Group M) are low risk herbicides - no resistance has been recorded.

Rotation of herbicide alone is not enough to prevent herbicide resistance. A combination of strategies including chemical, non chemical, cultural and grazing livestock options should be considered in a cropping enterprise.

Keep Accurate Records

Without accurate paddock records very little worthwhile planning can be made. If you don't know where you have been, it is very difficult to see where you are going.

Consult your reseller and District Agronomist and check the label to find out which herbicide group you are using and have been using.



Carefully study *"Weed Control in Winter Crops 1995"* (free from NSW Agriculture). This excellent booklet lists the herbicides, their preferred recommendation and the resistance groupings. It also outlines Herbicide Resistance Strategies and gives a complete listing of all the herbicide groupings and their risk factor.

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MANAGING SILVERLEAF NIGHTSHADE

B R Milne
Field Officer (Weeds)
Agricultural Research And Veterinary Centre, Orange

The Plant:
Silverleaf nightshade (*solanum elaeagnifolium*) also known as white horsenettle, and tomato weed was introduced from North America. It was first recorded in Melbourne, Victoria in 1909 and reported in Geelong, Hopetoun and Toolleen in 1918. The plant was first recorded in NSW at Parkes in 1922 and at Cowra and Koorawatha in 1923. Silverleaf nightshade is now widespread and a declared noxious weed in New South Wales, Victoria and South Australia.

Description:
Silverleaf nightshade (SLN) is a perennial plant growing up to 100cm in height, normally 30cm to 60cm high, the plant has a silvery white appearance due to a covering of fine white hairs. The leaves are alternate up to 10cm long and 10mm to 25mm wide, they are lanceolate-oblong to linear and waxy, they are a darker colour on the upper side than on the lower side of the leaf with prickles on the underside of the veins.

The plant has either a single stem or has several branches forming a stout bush, the stems rise from a strong creeping and rhizomatous root system, the stems usually have short slender spines.

Flowers are blue or violet, sometimes white, about 25mm across with 5 lobes borne in small groups towards the end of the branches. Flowering occurs during spring/summer and sometimes summer/autumn in some areas.

The fruit is a small round berry 8mm to 12mm in diameter, light green with dark green stripes turning orange when mature. Each plant can produce up to 4500 seeds which if viable are long-lived and are capable of lying dormant for several seasons until conditions are suitable for germination.

The seeds are spread readily by sheep, birds, machinery, water and in contaminated agriculture produce.

Silverleaf nightshade spreads rapidly through cultivation, the roots are cut into segments which readily regrow in moist soils. The plant recovers quickly from the remaining root stock after cultivation. Plants can regrow from root stock from at least 1 metre deep in the soil.

The plants grow rapidly during spring/summer under favourable conditions with several germinations of new plants and regrowth from existing root stock. The plants die off during autumn and the top growth is killed by frost.

The Problem:
Silverleaf nightshade competes with pasture regeneration, particularly sub clover and crops (summer and winter), in a heavy density of SLN wheat yields can be reduced by 50%. Silverleaf nightshade can reduce farming options such haymaking, pasture seed production, selling of livestock and reduce the value of land. Silverleaf nightshade is poisonous to livestock but is not readily eaten.

Pasture And Crops:
Pastures and crops that are tolerant (see herbicides) to the herbicides suitable for knockdown and prevention of seed set of SLN should be selected for sowing. Pasture species such as perennial grasses (phalaris, cocksfoot, ryegrass) and annual clover species (sub clover, medics) and summer crops such as sorghum and millet would be suitable.

Control:
Silverleaf nightshade is a difficult plant to control, there is no herbicide that will kill the plant in one application. Trials conducted by the Weeds Research And Demonstration Unit, Orange with district agronomists at Parkes and Mudgee have defined some suitable herbicides and rates of application for desiccation, prevention of seed set and a gradual reduction in plant numbers.

Herbicides:
Glyphosate 450g/L (Roundup CT®, Glyphosate CT®) and 2,4-D amine g/L have been the most successful herbicides (see table). Glyphosate 450g/ha is registered for fallow weed control but is not registered specifically for the control of SLN.

To be successful in controlling SLN the plant will need to be sprayed for several seasons, sometimes it may be necessary to spray twice in the one year.

The other herbicides that have given good results are Starane®, Trifolamine®, 2,4-D ester 800g/L and 2,4-D LV ester 400g/L.

Tordon 75-D® is the only herbicide registered for the control of SLN in NSW, a Pesticide Order is pending to allow the use of 2,4-D amine at rates of 1L to 2L/ha.

Table: Time of Spraying Trial - Gulgong.
Spray Dates: 10 December 1992---3 February 1993
20 January 1994--- 11 March 1994
16 December 1994---

Assessment Dates:
7 April 1993
28 April 1994
8 March 1994

		Silverleaf Nightshade Plants m^2 at Spraying and Assessment					
Treatment	No. of Sprays	10.12.92 Spray	7.4.93 Assess	20.1.94 Spray	28.4.94 Assess	26.2.94 Spray	8.3.95 Assess
Nil treatment	-	20	14	21	15	32	32
Roundup CT + Oil 2L + 2L	3	20	10	12	5	11	6
2,4-D amine + Oil 1.2L + 1L	3	20	4	12	2	13	4
2,4-D amine + Oil 1.2L + 1L	5	20	4	12	2	13	4

Spot Spray - High volume:
Single plants and small outbreaks of SLN are best controlled by spot-spraying. The most effective is Tordon 75-D®; however glyphosate (Roundup®,Glyphosate 360®) should be used in some situations.

Because Tordon 75-D® contains picloram which can be damaging to desirable flora it should not be used near trees, gardens or over large areas of legume pasture. In these situations products containing glyphosate would be the preferred herbicide due to it's low soil residue properties.

Herbicide Rate:

	Per 100 Litres Water	Comment
Tordon 75-D® (picloram 75g/L+2,4-D 300g/L)	650ml	Spray to thoroughly wet plants, avoid run-off, a total of 2000 to 3000 litres of spray solution per hectare may be required to completely wet heavy densities of SLN.
Glyphosate 360g/L (Roundup®,Glyphosate360®)	2L	Spray till plants are thoroughly wet avoiding excessive run-off, a total of 2000 to 2500 litres of spray solution per hectare is required to completely wet heavy densities of SLN.
2,4-D amine g/L (various trade names)	210ml-350ml	Spray to thoroughly wet plants.Useful for a quick knockdown result and to prevent seed set.

Time of Spraying:
Silverleaf nightshade should be sprayed when in full flower from late spring to mid-summer (depending on climatic conditions). Plants will have some small green berries but not mature orange coloured berries which would contain viable seeds.

Trial work at Parkes and Gulgong carried out by the Weeds Research and Demonstration Unit, Orange, (funded by NSW agriculture and the Grains Research and development Council) indicates that herbicide application in early summer (mid-December) will provide an excellent knockdown (plant desiccation) and prevent seed set. Follow-up spraying may be necessary in some seasons if SLN plants regenerate and flower.

The prevention of seed set is extremely important stop the spread of SLN.

For further information on the control of silverleaf nightshade contact your nearest NSW Agriculture District Agronomist or Noxious Plant Advisory Officer.

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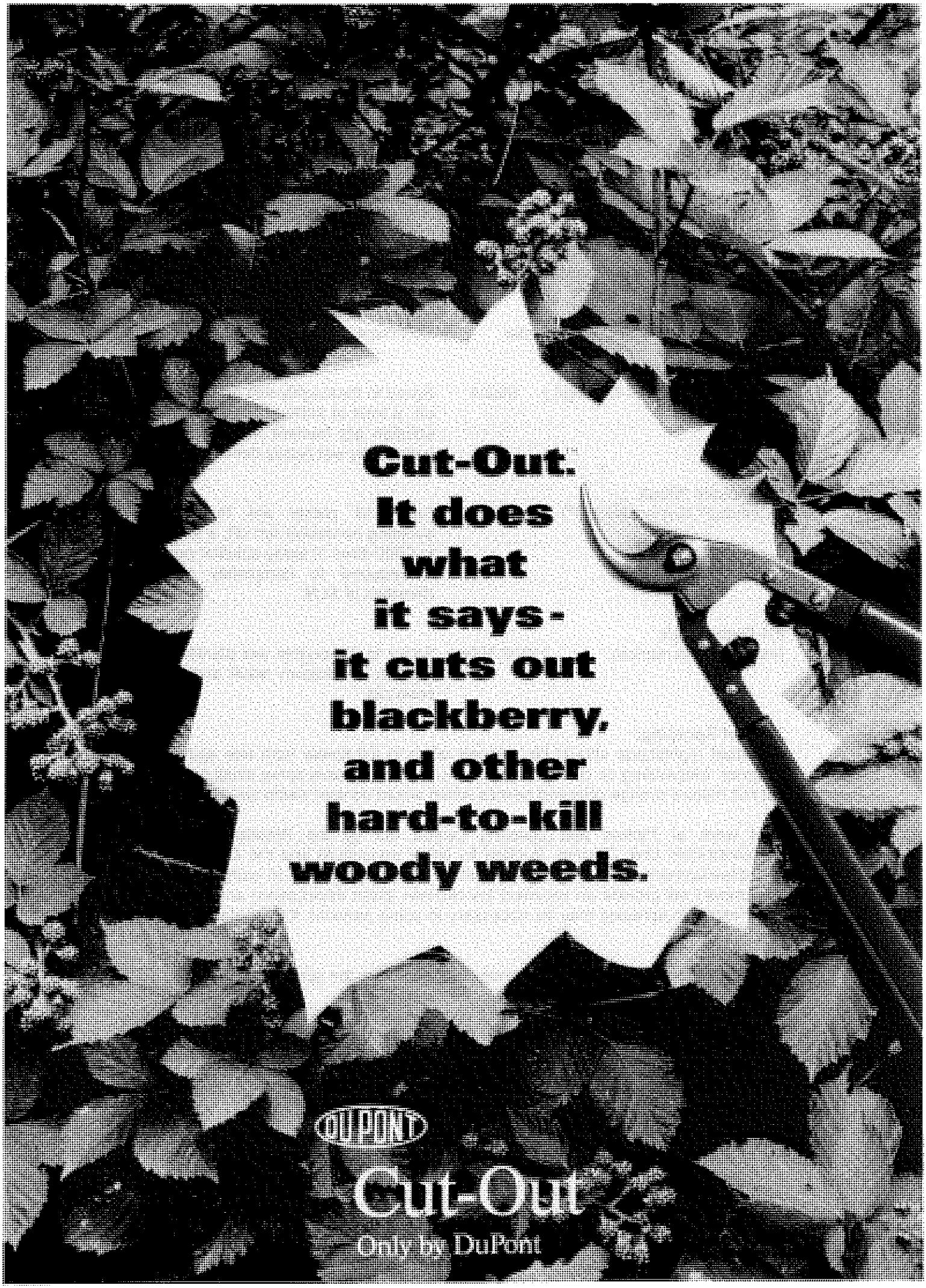
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PROPER MANAGEMENT OF EMPTY FARM CHEMICAL CONTAINERS

Douglas R McGuffog
Project Manager
McGuffog & Co Pty Ltd

Avcare Container Management

Abstract

Avcare Limited, the National Association for Crop Protection and Animal Health, has developed a Container Management Strategy as a self-regulating initiative for agriculture in Australia.

The industry's key objectives are:
to ensure that its packaging has a defined route for disposal that is socially, economically and environmentally acceptable and to reduce the amount of packaging waste at source.

The Avcare program is one of the industry's key environmental initiatives and is based on education of users, packaging reforms and the introduction of new technology which, collectively, have already achieved positive results.

Avcare's container management strategy is being implemented as a project supported by its members and farmer organisations throughout Australia and is managed by a Project Manager. Funding is by means of a levy on Avcare members based on the number of containers sold in Australia.

The major factor which limits Avcare's capacity to fully implement its objectives in relation to packaging is the absence of a recycling or material recovery program for plastic packaging.

The most desirable development from Avcare's point of view would be the establishment of a recycling program for plastic containers along the lines of the program for metal containers implemented by BHP and the Can Makers Institute of Australia. Recyclers who collect the containers are paid a rate per tonne for the material collected and BHP arranges and pays for the transport of the scrap to their processing facilities. Avcare, in conjunction with the Plastics and Chemicals Industry Association, is working towards the waste-to-energy option through the recycling of plastic as a fuel in cement kilns

Avcare is seeking the cooperation of local government in establishing cost effective means of collection, inspection, recycling and disposal of empty containers utilising the existing infrastructure already in place for the disposal of solid wastes.

1. Introduction

1.1 Avcare Limited

Membership
Avcare Limited is the National Association of companies in Australia engaged in the manufacture, formulation, distribution and servicing of crop protection and animal health products. Currently it has 52 members. In September 1993 the Association

changed its name from The Agricultural and Veterinary Chemicals Association (AVCA), to Avcare Limited.

Avcare members account for about 83% of the national sales of crop protection and animal health products, estimated at $1,200 million in 1994.

Purpose
Avcare's purpose is to achieve recognition for the crop protection and animal health industry as a vital link in high yield sustainable agriculture by:
Promoting the safe use of crop protection and animal health products throughout the community.

Representing the industry position on major regulatory and public policy issues to producers, government, community groups and the media, Avcare's primary objective is to create a positive change in attitudes and practices with regard to industry products.

Avcare aims to implement defined industry projects that promote and communicate the safe, effective and responsible use of products.
Avcare plays a strategic role in placing the views of the industry before the government, associated industries, producers, consumers and other interest groups.

1.2 The Crop Protection and Animal Health Industry

Industry products include crop protection products such as insecticides, fungicides, herbicides and plant growth regulators, which assist in the production of crops; and animal health products such as dips, drenches, antibiotics and other veterinary products that maintain animal health or promote animal growth. These products are often referred to as farm chemicals.

The large range of products on the market is a result of several factors. Australian agriculture is diverse, producing a wide variety of crop, horticultural and animal products. These industries are affected by a large variety of pests and diseases, many of which are specific to a particular crop or animal, and often require a particular crop protection or animal health product control measure.

Insecticides are used in urban areas by the pest control industry for preventative control of household pests and termites. Stored products such as foodstuff and grain may require protection from insect pests.

The government sector at the Federal, State and local levels use crop protection products for control of disease vectors that threaten public health, maintenance of railway lines, parks and gardens, roadsides and footpaths, and for tree and scrub control. Sporting clubs use crop protection products in the control of insect and fungal pests and diseases of turf, as well as for weed control.

There are approximately 1,900 crop protection and 2,200 animal health products available in Australia.

1.3 Packaging Used by the Industry

Number of Containers
An audit among Avcare members showed that 11-12 million packages were used by manufacturers for the packaging of end-use products in 1993. Over 99.5% of the packaged liquid products sold were contained in 3.9 million containers ranging in size from 1L to 200 L and over 99% of the solid formulations were in 1.1 million packages over 1 kg in size.
A summary of the survey findings is published in Avcare Insights Vol. 1 No. 4 1994. An overview of the results is attached as Appendix I.

Approximately 9% of the industry's liquid products are delivered as bulk or in refillable containers.

Community Concerns
Concerns have been raised by farmers, local government councils and regulatory agencies about the disposal of farm chemical containers. The Senate Select Committee on Agricultural and Veterinary Chemicals in Australia (Report 1990), recommended the development of strategies for the safe and effective disposal of chemical containers. Avcare responded by participating with regulatory agencies, farmer organisations and the packaging industry to assist in the development of recommendations for a national strategy, and by defining its own position and strategy to find solutions to the problem of container disposal.

The Australian and New Zealand Environment and Conservation Council (ANZECC) established a Task Force on Farm Chemicals Container Management to review existing container management strategies. Its draft National Strategy for the Management of Empty Unwanted Farm Chemical Containers was published on 29 June 1995 and has been widely distributed for public comment with submissions due by 21 September 1995.

2. Avcare Container Management Strategy

2.1 Strategic Objectives

Avcare Limited has developed a Container Management Strategy as a self-regulating initiative for agriculture in Australia.

The industry's key objectives are:
to ensure that its packaging has a defined route for disposal that is socially, economically and environmentally acceptable, and to reduce the amount of packaging waste at source.
Avcare has developed a strategy to achieve its objectives involving the following key programs:

Reduction in the number of containers requiring disposal through greater use of refillable containers, formulation innovation and use of water soluble packaging.

The education and extension campaign Operation Clean Rinse which has as its aim the promotion of the proper rinsing of empty containers and the inspection of empty containers before they are accepted for recycling or disposal to landfill.

Improved and more uniform container design standards to make containers easier to rinse and inspect, safer to handle and more suitable for recycling.

Collection and recycling of cleaned containers for their energy or material value.

To finance the implementation of the programs Avcare introduced a compulsory annual levy on its members for each non-refillable 1 to 200 L/kg primary container, excluding water soluble packages.

The program is supported by the voluntary efforts of industry members and farmer organisations and the services of a consultant as Project Manager.

2.2 Disposal and Recycling Strategies

Water Soluble Packaging
This form of packaging involves the use of poly vinyl alcohol film that is soluble in water and is used to package dry formulations (powders and granules) and gel formulations.
Its major advantages are that the operator does not come in contact with the chemical which is pre-packaged in sachets. These are added directly to the spray tank, and the package itself dissolves in the mixing tank leaving no contaminated packaging to dispose of.

Container Re-use
There is limited scope for the re-use of empty farm chemical containers because of the risk of contamination and the associated potential liability.

Several companies use the services of Cycle Drums Pty Ltd who collect empty plastic 20 L herbicide drums, clean, recondition and resell them to the sponsoring company for re-use in packaging the same product. Cycle Drums pays 50 cents to recyclers for each drum collected, arranges and pays for transport of truck load lots of containers to its Victorian plant.

This system cannot be applied to all products. Limitations include: the high cost of transport (eg there is no scheme for North Queensland), restrictions in handling certain hazardous products, the high cost of reconditioning containers below 20 L in size and its restriction to high volume lines where the drum can be used again to package the same product.

Refillable Containers and Bulk Deliveries
There has been a significant trend toward the use of refillable, 1000 L mini-bulk containers in the cotton industry for the distribution of insecticides and defoliants, and for aerial spraying of insecticides in winter grain legume crops in southern and western Australia.

Small volume refillable containers (SVR's) ranging in size from 50L to 200L that are fitted with low cost, one-way, tamper evident valves, are now being introduced into the grain and horticultural industries.

The one-way valves are designed to allow the extraction of the drum's content but prevent the inadvertent or deliberate introduction of foreign liquid. This in turn enables

the container to be refilled without the fear that it has been contaminated with another product.

These developments will lead to considerable expansion of the use of SVR's by smaller users and in a much wider range of market segments, with a corresponding reduction in the use of single-trip containers requiring disposal.

Material Recovery and Recycling
Despite initiatives by the industry to reduce the number of containers necessary to service the needs of Australian agricultural producers, the use of single-trip containers cannot be entirely eliminated.

Avcare is now seeking to develop recycling strategies for both metal and plastic containers. The scope for recycling plastic containers is limited by the risk of contamination from the retention of minor levels of chemical residue either absorbed into the plastic, or retained after rinsing.

Metal Containers
Avcare is working in cooperation with the Can Makers Institute of Australia and BHP to promote their established recycling program for steel containers. Empty, rinsed and inspected steel crop protection and animal health containers are accepted by the program which pays recyclers $50 per tonne for containers that have been crushed and/or baled, and pays for their transport, in truck load lots, to BHP's smelting facilities.

Plastic Containers
Most currently used farm chemical plastic containers are manufactured from high density polyethylene (HDPE). Because of the risk of minor contamination, empty crop protection and animal health product containers cannot be accepted into the general stream of recycled plastic used to mould new plastic articles.

The only universal method acceptable as an end use for empty, rinsed farm chemical containers in North America is as a secondary or supplementary fuel source in cement kilns.

In the Netherlands, rinsed containers are accepted in the municipal waste stream which in turn is used as an energy source in the production of electricity. In Scandinavian countries a large proportion of containers are accepted for co-disposal with municipal waste which is used for generation of electricity.

In Australia, the most viable potential disposal route, identified to date, for empty plastic farm chemical containers is to use them for their energy value as an alternate fuel source for the operation of cement kilns.

Cement Kiln Operation
Cement kilns in both the USA and Europe recycle plastic by utilising it as a fuel source. In a cement kiln, limestone, shale or clay and other minor components are mixed together and heated to form cement.

This high temperature process allows safe and environmentally sound disposal of plastic waste.

The Senate Standing Committee on Environment, Recreation and the Arts (Report on Waste Disposal, 1994), believes that the option of using cement kilns in waste disposal had not been used to its full potential in Australia and recommended that the Federal Government investigate the potential and feasibility of using cement kilns for the disposal of particular waste streams.

The amount of high density polyethylene plastic used annually in farm chemical containers in Australia is estimated at 2 000 to 2 500 tonne. However, a cement kiln operator would require an assured supply of 9-10 000 pa. to justify the capital expenditure needed to adapt their kiln to accept plastic waste as fuel.

Avcare is working with the Plastics and Chemicals Industry Association (PACIA) and the cement kiln industry in an endeavour to develop waste to energy recycling of plastic that cannot be used as a regrind for re-manufacture.

The feasibility for using cement kilns in the disposal of crop protection and animal health product containers will depend on linking cleaned containers from Avcare's program with a sufficiently large HDPE stream coming from the collection of general household packaging, industrial and other rural plastic waste such as mulching film.

Until a material recovery program for plastic containers can be developed the only disposal route for non-refillable containers is in landfill.

Role of Local Government

Avcare has conducted extensive research into the current practices for container management and disposal among farmers and local government.

A copy of the findings and recommendations arising from the local government survey was mailed to all councils and local government associations in January 1995. A summary of the findings from the farmer survey was published as a supplement in The Land, 18 May 1995. Both these reports are available on request from Avcare Limited, Locked Bag 916, North Sydney, NSW 2059.

A summary of the disposal methods used by farmers is attached as Appendix II and the proportion of councils accepting empty containers as Appendix III.

The surveys have identified a critical role for local communities in establishing collection and inspection programs that will facilitate the removal of containers from farms and ensure that they are disposed of in a way that will not pose a threat to public health or the environment.

Avcare believes that the most cost effective means of establishing these programs is to use the existing local government council infrastructure.

Two pilot programs were established in 1993 to test the feasibility of introducing collection schemes which include an inspection step and to use the containers for trial purposes in recycling uses. One scheme was based at Horsham in Victoria, and the other at Cunderdin in Western Australia.

Results from these programs have demonstrated that it is practical to establish collection programs in rural areas of Australia. Farmers responded positively to an education program undertaken in Horsham area prior to the commencement of the

collection program by delivering over 95% of containers in a properly cleaned condition.

The visual inspection procedures used in the Horsham project proved to be an effective means of assuring that only containers cleaned to a high standard were accepted. The recommended inspection procedures have been published as *Operation Clean Rinse, Information Bulletin No. 3.* A copy of the bulletin was mailed to all local government councils in 1994. Additional copies are available on request from Avcare Ltd.

3. Conclusions

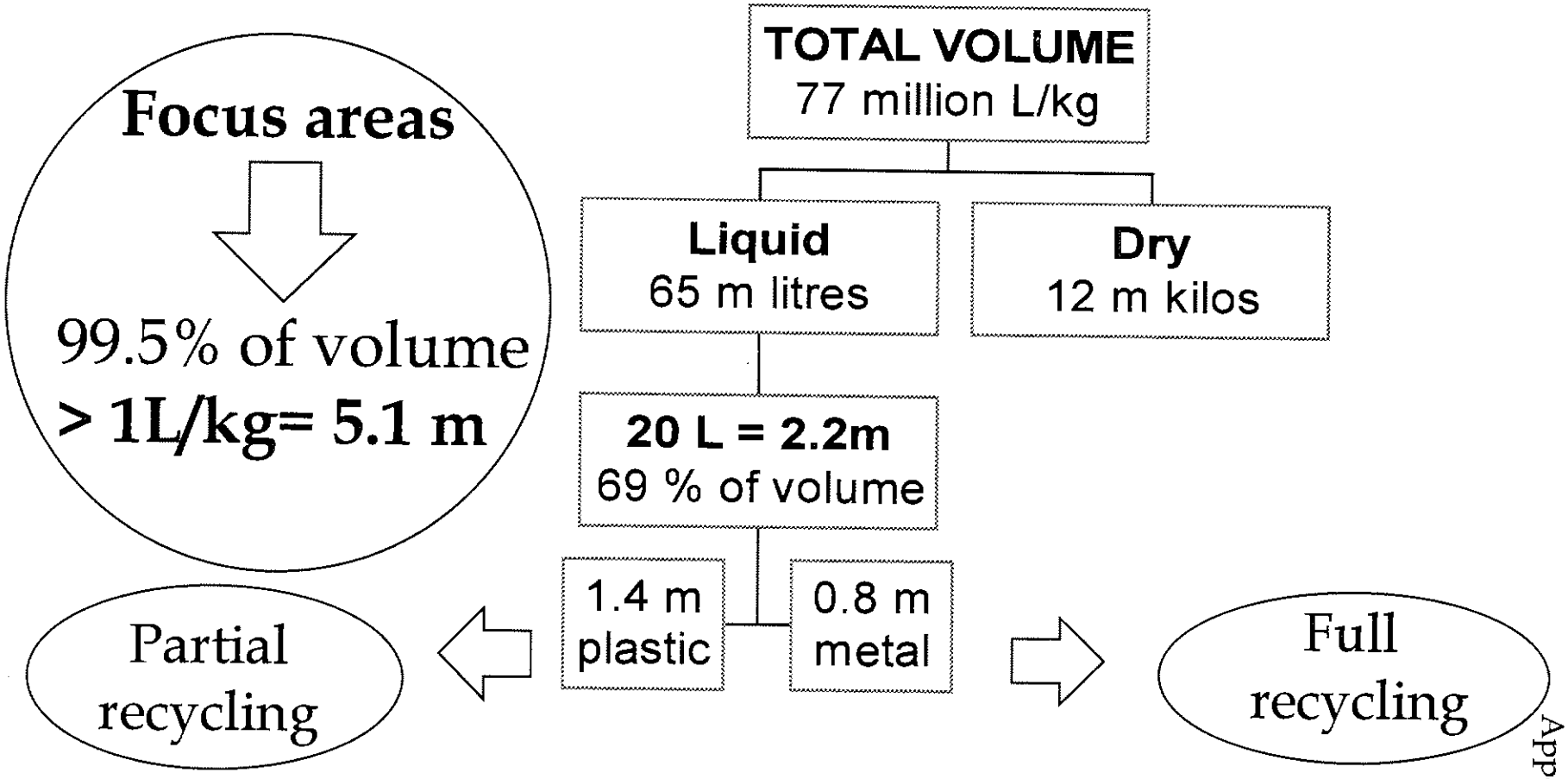
3.1. The major factor which limits Avcare's capacity to implement its objectives in relation to packaging is the absence of a recycling or material recovery program for plastic packaging.

3.2. The most desirable development from Avcare's point of view would be the establishment of a materials recovery program for plastics containers in a similar fashion to that established by BHP and the Can Makers Institute of Australia for metal containers.

3.3. A cooperative effort, including the utilisation of existing local government infrastructure, is required to achieve Avcare's objectives and to implement the draft National Strategy for the Management of Empty Unwanted Farm Chemical Containers developed by ANZECC.

Avcare

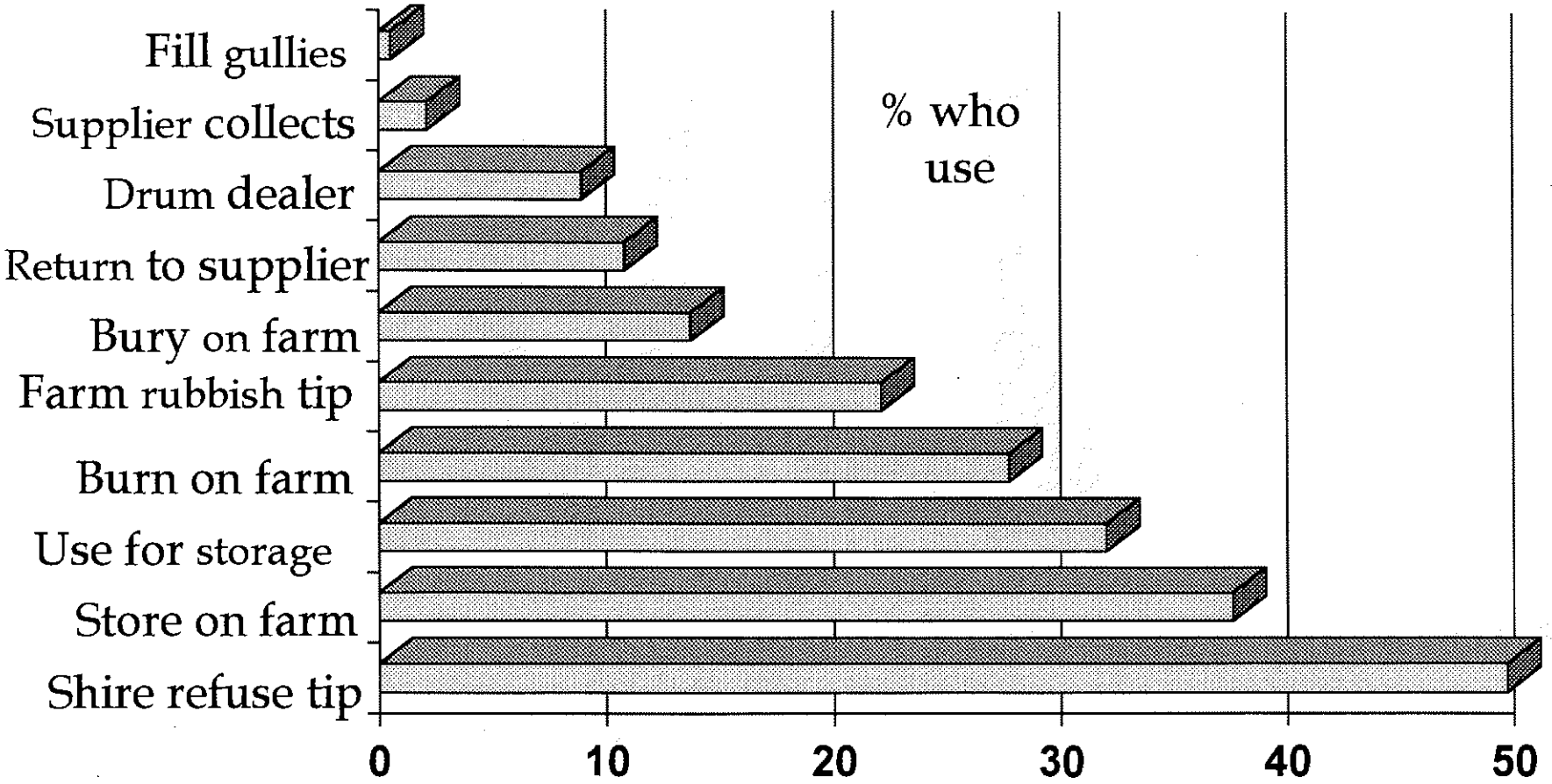
Container Management Program



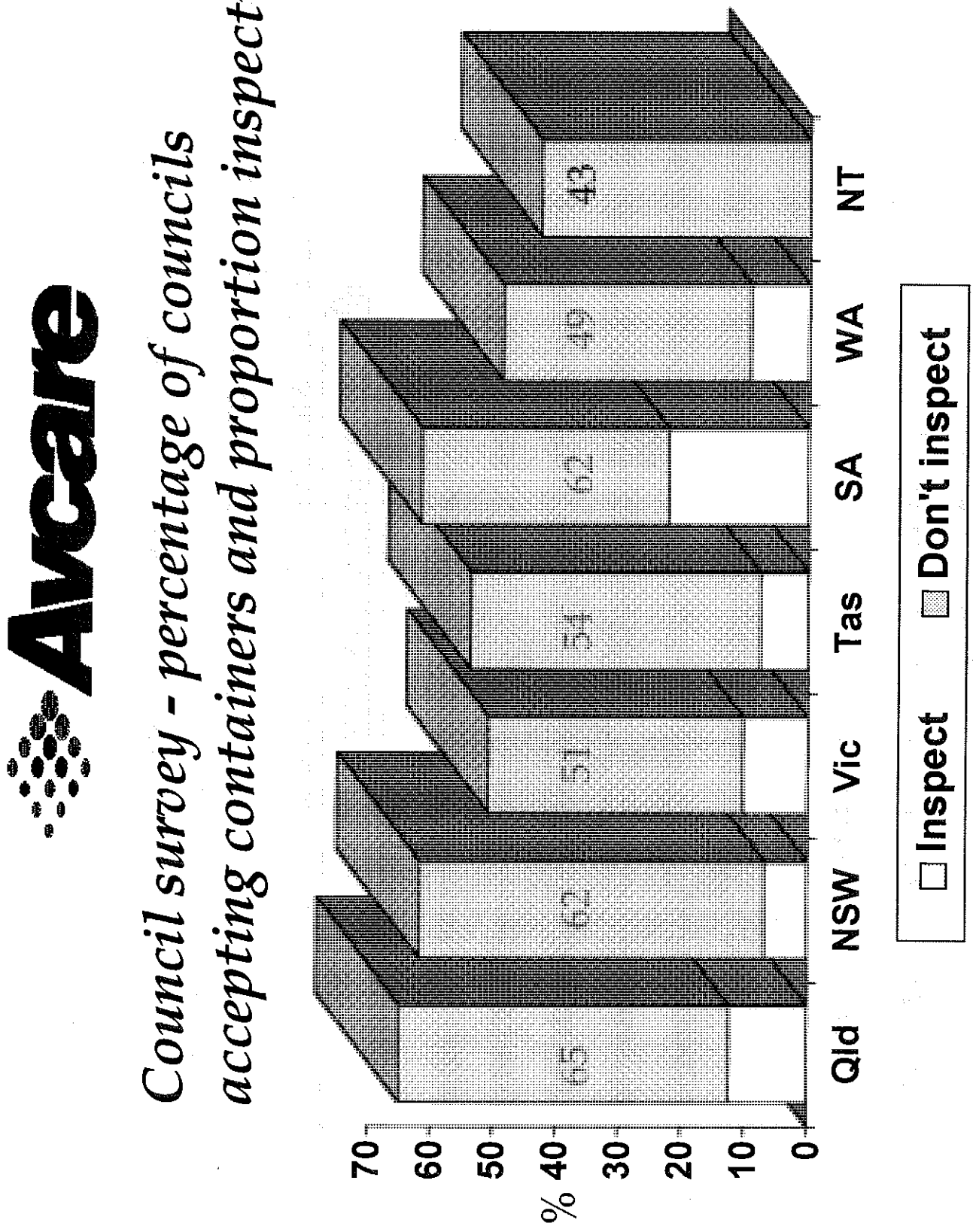
Appendix I

Avcare

Farmer survey - container disposal methods used by farmers



Appendix III



ANALYSING WEEDICIDE AND PESTICIDE RESIDUES FOR COMPLIANCE TO OCCUPATIONAL GUIDELINES

Paul Donkin (Departmental Professional Officer)
Robert Geyer (Co-Ordinator) speaker
Laboratory Services Unit, WorkCover Authority of NSW.

Introduction

The widespread use of pesticides and weedicides over the last 50 years has resulted in a significant awareness amongst professional users of these chemicals of their potential hazards to human health. Noxious weed sprayers throughout Australia have for some time now been concerned about the quantities of chemicals that they have been handling over the years and the length of time that they have been potentially exposed to these chemicals.

Attitudes have changed over the years to such an extent that professional users of such chemicals are aiming to reduce the absorption of pesticides and weedicides into their bodies as much as possible.

While various protective measures are available to minimise the risk of chemical exposure, the net effect and efficiency of the measures are best assessed by biological monitoring. Biological monitoring is essentially a preventative activity. It is defined as the assessment of the overall exposure of workers to workplace chemicals, through the measurement of appropriate biological markers.

For example (i) the exposure to weedicides such as 2,4-D can be assessed by measuring this chemical in urine, (ii) Organochlorine pesticides exposure can be measured by blood analysis and (iii) measurement of the inhibition of the enzyme cholinesterase can be used to assess exposure to organophosphate pesticides such as diazinon or chlorpyrifos. A quantitative assessment of risk is then appreciated when the results of biological monitoring are compared to occupational guidelines or limits.

The Laboratory Services Unit

The Laboratory Services Unit of the WorkCover Authority of NSW is a specialised analytical service focusing on the determination of many hazardous substances in the workplace environment.

The analytical chemists of the laboratory have a great deal of experience in the analysis areas of (i) pesticide exposure (ii) trace metal/element exposure (iii) solvent exposure (iv) dust exposure and (v) various inorganic and organic substances including carcinogenic chemicals. The laboratory tests are needed for both workplace and worker assessments.

In workplace assessments, a safety officer, inspector or occupational hygienist may request the laboratory to analyse air samples, dusts or other samples to determine if there is an occupational health risk.

A urine or blood test for a target chemical can be used to determine if there is a significantly high level for a doctor to advise either removal of that person from certain duties or a review of that individual's work practices.

Analysis of Weedicides in the Urine of Occupationally Exposed Workers

As a brief example of the type of chemical analyses undertaken, which is appropriate for this meeting and which demonstrates the technology involved, we will discuss the analysis of weedicides in urine.

Before we can analyse for such chemicals as weedicides in urine, it is important to note that these chemicals are generally excreted from the body fairly rapidly. Urine samples need to be collected after the shift has finished or at latest within a few days after the exposure. When sending the samples to the laboratory for analysis they need to be kept cool so that there is no deterioration in the sample condition.

With our sample bottles, the reason that we use glass with a foiled lined lid is to prevent the urine from coming into contact with plastic or rubber for any significant period of time. There are certain chemicals present in plastics and rubbers which can be leached into the urine and hence can interfere in our testing.

In order to successfully analyse weedicides such as 2,4-D, dicamba, picloram, triclopyr, clopyralid and bromoxynil in urine samples at the parts per billion level we must use an analytical procedure which extracts the chemicals from the urine. This is important because the gas chromatograph instrument which is used to analyse the weedicides at such low levels requires relatively `clean' volatile solvent extracts. If urines were injected directly onto the gas chromatograph then in a very short time the columns and detectors of the instrument would `clog up' and the instrument would cease to function. Since the above weedicides are `acidic' organic substances the first step in our method is to acidify the urine sample with hydrochloric acid.

The purpose of this is to make sure that the weedicides remain in an acidic or non-polar or `neutral' form in solution. In order to extract the weedicides out of this acidic urine solution we now mix and shake the solution up with an aliquot of very pure toluene solvent. This mixing and shaking action serves to induce the weedicide chemicals out of the urine and into the toluene where they prefer to be. This is because the toluene is quite neutral or non-polar compared to the urine and hence the non-polar weedicides quickly move or `partition' into the toluene solvent.

Once this extraction step is complete we must separate the two different liquids from each other using a centrifuge. The toluene layer sits on the top because it is `lighter' than the heavier watery urine layer on the bottom of the test tube. Now we take an aliquot of the toluene solvent, dry it with some anhydrous sodium sulphate in order to get rid of any traces of water. The next step in the procedure works better if the conditions in the test tube are nice and dry (ie., free of water).

In order to get these weedicides to run easily through the gas chromatograph instrument we need to make them more volatile and even more non-polar. We achieve this by methylation. We chemically react the weedicides with diazomethane to form the methyl esters. This diazomethane solution has to be made up fresh each time. Once the weedicides have been methylated we can inject the sample solutions, which are dissolved in toluene , into the gas chromatograph.

The Gas Chromatograph is basically a special type of oven with an injection port on one end and a detector part on another. In between there is a special glass column

with a narrow bore through the centre. Gas flows through this system so that a sample can be swept from the injector via the column through to the detector.

This detector is vital to the analysis. It detects the individual weedicides as they reach the detector in the form of a spike or `peak'. The column has the special property that it selectively allows certain chemicals with particular structures to pass through the column quicker than other chemicals. The exact time that it takes for each of the individual weedicides to reach the detector is a characteristic of that particular weedicide.

This time is measured very accurately in 1/100's of a second. Every time the test is performed the same chemicals exhibit the same retention times, provided that the conditions of the test have not changed. The size of the peak is proportional to the amount of the weedicide present in the sample. The data produced in such a test is compared to that of known analytical standards where we know the identity and exact concentration of the weedicides.

The data is typically displayed in the form of a chromatogram which is a type of graph which shows the results of a gas chromatograph test. The chromatographic analysis is actually performed twice at the same time by splitting the sample after injection into the instrument and running it down two columns simultaneously. The advantage of this is that if two very different columns are used then the data produced will be different for the two columns and hence confirmatory information is obtained.

Creatinine Correction of Results

Once the results have been produced from the gas chromatography analysis they are initially expressed as an amount of weedicide per volume of urine. This would be fine if everyone produced the same volume of urine in a day. Because this is not the case we need to apply some sort of correction so we can more reasonably compare differing urine results.

Take an extreme example; two workers were exposed to the same amount of 2,4-D on a particular day and they both absorbed the same amount of the chemical into their bodies. If one person was working in a very hot environment, perspired a lot and didn't drink much fluids then you would expect their urine to be much more concentrated than another worker who was working in a much cooler climate, didn't perspire a lot and drank plenty of fluids all day long.

Although both workers absorbed the same amount of 2,4-D their levels would be very different due to the volume of urine they could each produce. Hence it is desirable to measure this 2,4-D level against a factor for which the amount of excretion from the body is known to be fairly constant over time.

Creatinine is one such substance and one which can be readily measured in the laboratory.

Creatinine, which is found naturally in the body, is a by product of muscle metabolism and is excreted from the body in the urine. For any given person, the overall amount of creatinine excreted in the urine does not vary significantly over time under normal routine conditions. The excretion rate remains fairly constant regardless of fluctuations in urinary fluid volume.

Hence by expressing the 2,4-D result in terms of an amount per gram of creatinine instead of a volume of urine we overcome the problem discussed above.

LD50's

Some chemicals are more toxic than others. The term LD50 is used to show the relative toxicities of different chemicals. A single dose of a chemical that kills 50% or more of a test group of animals (usually rats) is expressed as mg of chemical per kg of animal body weight or LD50.

Table 1 shows the relative toxicities of two commonly used weedicides (glyphosate and 2,4-D), a popular organophosphate insecticide (chlorpyrifos) and two highly toxic inorganic poisons (arsenic and cyanide). This LD50 data together with important biochemical factors such as the metabolism and pharmacokinetics of the chemical, the uptake of the chemical by all possible routes of exposure and the health effects from occupational exposure are all used in setting occupational guidelines.

TABLE 1 - RELATIVE TOXICITIES

CHEMICAL	ORAL LD50(mg/Kg) Rats	Ref
Glyphosate (Roundup)	4320	1
2,4-D Ester	500	1
Chlorpyrifos (Dursban)	163	1
Arsenic Trioxide	15	2
Potassium Cyanide	10	2

Ref 1 : "Toxic properties of pesticides"
N.P. Cheremisinoff & J.A. King. Marcel Dekker 1994

Ref 2 : "Merck Index" 11th Edition 1989

Occupational Guidelines

In an ideal situation workers should not be absorbing any chemicals such as weedicides into their bodies. In reality this is not the case due to imperfections in work practices. Occupational limits are set with such practical situations in mind. In the case of the heavy metal, lead, occupational limits or guidelines are relatively easy to set due to the extensive amount of international data available on its toxicology and the existence of occupational limits in many industrialised countries of the world.

For chemicals such as the weedicides 2,4-D, triclopyr, dicamba and picloram the picture is not so clear. The literature on hand is not so extensive but available toxicological data indicates that these chemicals are probably of low toxicity. Certainly, there are very few, if any, countries in the world where occupational limits have been adopted for the herbicides mentioned above.

The WorkCover Authority's 100ug/g creatinine occupational limit for the above mentioned weedicides is meant to be used as a guide rather than a legal limit.
A result of 99ug/g is probably not significantly better than a result of 101ug/g, although one is below and the other is above the recommended occupational limit. Results down at the detection limit (10ug/g) of the method are obviously more desirable if a positive result is to be the outcome.

CONCLUDING REMARKS

In 1994 Worksafe Australia introduced the National Model Regulations and Code of Practice for the Control of Workplace Hazardous Substances. This has set the scene in NSW for the introduction of WorkCover's own Hazardous Substances Regulations which when introduced will make it mandatory for employers to provide a health surveillance or biological monitoring program for their employees who handle hazardous substances.

One of WorkCover's main objectives has always been to work with industry to prevent work related injury and illness by improving health and safety. By offering a chemical testing service in the area of hazardous substances WorkCover hopes that the testing data supplied can be of great benefit in helping to evaluate hazardous situations in the workplace environment.

As a testing laboratory we are always trying to develop new methods of analysis for an ever increasing number and variety of weedicides. We do not have tests for all of the weedicides on the market at present.

The analysis of such chemicals in urine or blood samples at the pars per billion level is quite a challenge. The improvement of monitoring procedures and their associated health benefits to professional users of weedicides and pesticides can be promoted by maintaining effective liaison with laboratories such as our unit at the WorkCover Authority of New South Wales.

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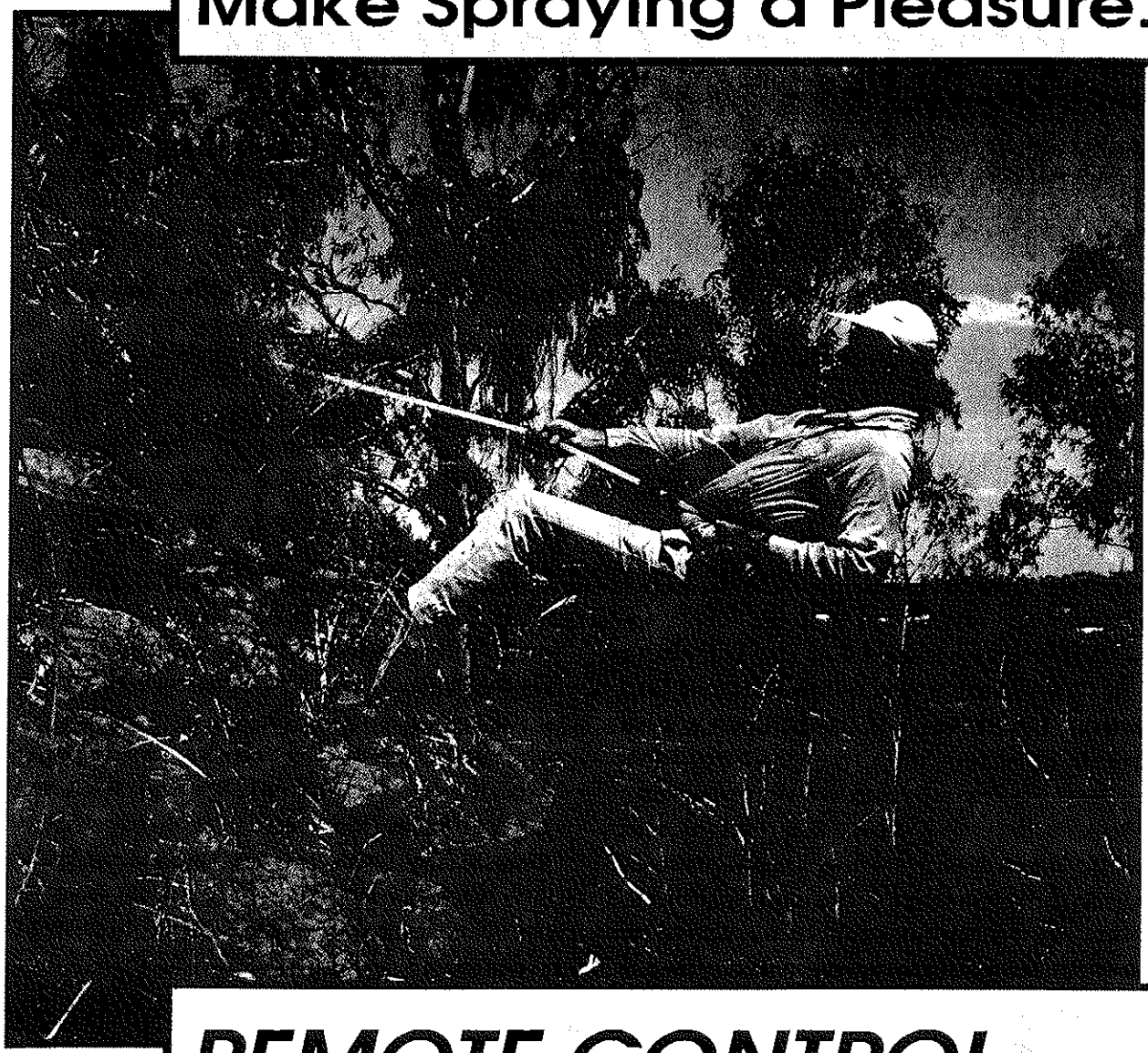
QUIK SPRAY

Make Spraying a Pleasure.



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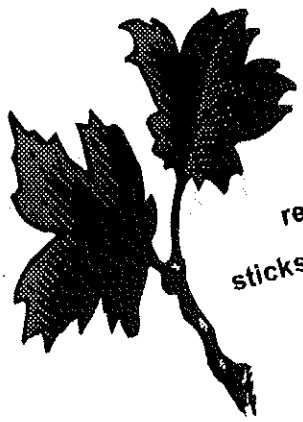

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ADJUVANTS

FUTURE TRENDS

A B McLennan HDA
MARAC

Abstract

The environmental lobby, plus strong community pressure, is changing the way noxious plant control programs will be handled in the future.

We regularly see press reference to the world-wide desire to minimise reliance on pesticides as we approach the year 2000.

The Australian Horticultural Industry have set a reduction target of 50% within the next decade. City and Urban Councils are also targeting alternative measures of control, even though there are significant cost increases.

Integrated Pest Management Strategies, coupled with the use of more environmentally friendly products, are the "way ahead".

Noxious Plant Officers of the mid-90's have a wide range of technologies to help them such as, aerial mappery, computer programming, global positioning systems, modern equipment and much safer pesticides - both to operators and the environment.

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PRICKLY PEAR - A NEW "NOXIOUS WEED"

L.R. Tanner
Senior Inspector
Weeds Sub-Program
NSW Agriculture, Orange

Abstract

Prickly pear has been a major pest plant in New South Wales for more than 100 years.

Tremendous effort by generations of landholders, and an outstanding commitment by numerous Departmental officers, over many years, has been invested in the prickly pear control program.

Improved herbicides, better use of biological control methods, a prolonged pattern of dry weather conditions, and changing rural priorities have, particularly over the last decade, led to a marked decline in prickly pear control activities.

In the past ten years, the number of staff involved in administration of the Prickly Pear Act 1987 has been reduced from FORTY FIVE to the equivalent of TEN (in combination with other projects being undertaken by NSW Agriculture's Weed Biological Control Unit).

Prickly pear, generally, is controlled throughout New South Wales. It is time to hand the baton over to local government. This paper sets out the logistics for implementing such a change.

Background

Prickly pear has proven to be one of the worst and most invasive weeds ever imported into Australia. During the early part of this century, prickly pear had a devastating impact on life in rural eastern Australia. Special Acts of Parliament were passed to enforce strict control measures in an attempt to halt its spread through Queensland and New South Wales. The history of prickly pear in Australia started two hundred years ago.

The Spread of Prickly Pear in Australia

The first plants of prickly pear were brought into Australia on the First Fleet. Captain Arthur Phillip collected a number of plants infested with cochineal insects, from Brazil on his way to establish the first white settlement at Botany Bay.

At that time, Spain and Portugal had a world-wide monopoly on the important cochineal dye industry and the British Government was keen to set up its own source of supply within its dominion. The red dye derived from cochineal insects was important to the western world's clothing and garment industry. It was the dye used to colour the British soldiers' red coats, for example.

It was at the instigation of Sir Joseph Banks that a cochineal dye industry was established at Botany Bay.

Little is known of the fate of those first plants introduced by Captain Phillip, but it has been established that the variety of prickly pear was "smooth tree pear" (*Opuntia*

vulgaris). This type of cactus is still found along coastal areas of New South Wales. It never developed into a major problem.

"Common pest pear" (*Opuntia stricta* spp.) was the variety of prickly pear that overran New South Wales and Queensland between 1900 and 1930.

There is no information on the original introduction of common pest pear into Australia from the Americas. It was first recorded as being cultivated for stock fodder in the Parramatta district in the early 1800's. There is also a record of a pot plant being taken to Scone, NSW in 1839 where it was grown in a station garden. The property manager later planted it in various paddocks with the idea that it would be a good stand-by for stock in a drought year.

It is also known that a plant was taken from Sydney to Warwick, Queensland in 1848 for use as a garden plant, with a strong recommendation that it would be a good fruiting and hedge plant!

Early settlers took plants to other parts of New South Wales and Queensland because of its potential use as an alternate food source for stock, especially during dry times. It was also planted at various homesteads as a hedge. The hedges flourished and bore fruit. Excess pieces were dumped in the bush. With all of this help, prickly pear quickly established over a large area.

Prickly pear literally exploded! The accommodating climate and the general lack of natural enemies accounted for its amazing spread - still considered by many experts to be one of the botanical wonders of the world.

Legislation to Control Prickly Pear

Prickly pear started to cause concern about 1870, but it was not until 1886 that **the first Prickly-pear Destruction Act** was passed. This Act placed obligations upon owners and occupiers of land to destroy pear. The Act provided for the appointment of inspectors to implement its provisions.

Some amendments to the Act were carried out in 1901. Major amendments were made in 1924 when a **Prickly-pear Destruction Board** was set up, with wide powers to deal with the prickly pear problem. By then, however, the horse had bolted!

By 1925, prickly pear was completely out of control, infesting some twenty five million hectares in New South Wales and Queensland. It was spreading at the rate of half a million hectares a year and nobody could stop it. Tremendous effort went into mechanical and chemical treatment programs, but these could not contain the pear. The answer finally came in the form of biological control.

As the amazing spread of prickly pear in eastern Australia was considered to be one of the botanical wonders of the world, its virtual destruction by Cactoblastis caterpillars (*Cactoblastis cactorum*) is still regarded as the world's most spectacular example of successful weed biological control.

The first liberations of cactoblastis caterpillars were made in 1926. Within six years, most of the original, thick stands of pear were gone. Properties previously abandoned were reclaimed and brought back into production.

But, while this sounded like the end of the prickly pear problem, the story certainly continued ...

Cactoblastis was not effective in all areas. Cooler climates were less favourable for insect proliferation - other forms of control had to be pursued.

And, while common pear received all the "limelight" from 1900 to 1930, other varieties of prickly pear were becoming established. One of these was **"tiger pear"** (*Opuntia aurantiaca*), which is now our worst prickly pear variety.

Further Amendments to the Act

The Prickly Pear Act, 1924, was amended in 1944. That Act, 1924-1944, remained in force until 1987 when the current Prickly Pear Act, 1987 was introduced.

The Last Ten Years

The Prickly-pear Destruction Commission was disbanded December 31, 1987 after a total operating period of **62 years**. Remaining staff were transferred into what was to become the Weed Biological Control Unit, and this Unit continued the administration of the Prickly Pear Act 1987. Most staff began to move into the area of biological control of weeds, e.g. programs on Paterson's curse, St John's wort, water hyacinth, Scotch broom.

During the latter stage of the Prickly-pear Destruction Commission's era, significant advances were made with the introduction of improved herbicides, motor vehicles and other equipment. Of more significance, as time has shown, was the decision to divert most of the Commission's resources into an enhanced biological control program throughout the State.

Coupled with coincidental, lower-than-average rainfall in the State's north over the past decade, the biological control program has been extremely successful.

Changing rural priorities have also seen more acceptance of prickly pear as part of the natural environment. Indeed, there are many areas within the State where prickly pear is regularly maintained at an acceptable level by biological and other natural means.

Such has been the success of the past ten years, that staff numbers involved in administration of the Prickly Pear Act have been reduced from FORTY FIVE to the present equivalent of TEN (this regulatory function is combined with other projects being undertaken by NSW Agriculture's Weed Biological Control Unit).

The Present Situation - Prickly Pear

The Prickly Pear Act 1987 defines prickly pear thus:

> *"**Prickly pear**" means a plant of any species within the cactus tribe Cacleae (or Cereeae), Opuntieae or Pereskieae, but does not include any such plant that is of a kind prescribed for the purposes of this definition."*

This legal definition of prickly pear therefore takes in **ALL** cacti, and there are over eight hundred (800) different types. The reason behind this "broad-brush" approach is

because Australia has no native cacti - all species now in Australia have been introduced from overseas. Their capacity to proliferate in this country is unknown. Therefore, they must all be viewed as potential pests until proven otherwise.

Only one cactus species has been prescribed under the Act and is not therefore included in the definition of prickly pear. "Indian fig", *Opuntia ficus-indica* was removed from the definition by an amendment in 1978 to the Act which preceded the current Act. Indian fig is popular for its edible fruit. It is not regarded as a threat to rural lands - its lack of spines allows it to be readily grazed by hungry stock.

While all cacti, except Indian fig, are actually illegal under the Prickly Pear Act, regulatory action is only taken against the main varieties of prickly pear i.e. those species that have already demonstrated their potential to become serious pest plants.

Pest species

The varieties with demonstrated potential to become pest plants are:

Common pest pear (*Opuntia stricta* and sub species.)
Riverina pear (*Opuntia bonaerensis*) (syn. *O. paraguayensis*)
Araluen pear (*Opuntia lindheimeri*)
Smooth tree pear (*Opuntia vulgaris*)
Tiger pear (*Opuntia aurantiaca*)
Creeping pear (*Opuntia humifusa*)
Devil's rope pear (*Opuntia imbricata*)
Wheel cactus (*Opuntia robusta*)
Velvety tree pear (*Opuntia tomentosa*)
Old man's beard (*Opuntia streptacantha*)
Harrisia cactus (*Eriocereus martinii*)
Harrisia cactus (*Eriocereus tortuosis*)

Common pest pear infests some 1,000,000 hectares of land in New South Wales but is generally under control. However, there are problem areas in several districts, including the Hunter Valley, Turon/Macquarie Rivers, Mudgee and Rylstone.

Tiger pear is the biggest problem. Spread by floodwaters, major infestations occur along lands adjacent to the Turon, Macquarie, Castlereagh, Goulburn, Hunter, Namoi, Peel, Severn, Moonie, Horton and Gwydir Rivers. Approximately 170,000 hectares of grazing land is affected, and if biological control was not an option, the estimated cost to chemically treat would be in excess of $3.5M per annum

Harrisia cactus continues to slowly spread from Queensland into northern New South Wales. Biological control is reasonably effective.

Tree pear, rope pear and other minor species pose no major threat. Isolated problem areas exist but present biological and chemical control methods are effective.

Changeover Strategy - State to Local Government

The Prickly-pear Destruction Commission and its Departmental successor, the Weed Biological Control Unit, have achieved significantly reductions in prickly pear levels throughout the State. The number of staff engaged fulltime on prickly pear regulatory work has been reduced from 45 to 10.

With local government council weed authorities continuously improving their property inspection and advisory operations, it is now an appropriate time to hand the prickly pear regulatory function over to local government.

The people of rural New South Wales and the Government have made a huge commitment, over many years, to the control of prickly pear in the State. It will be important, therefore, to allocate a reasonable period of time for training of local government weeds inspectors in this new area of responsibility. The training process will involve:

- Location of all known infestations - this will involve checking all properties currently listed on Weed Biological Control Unit files
- Identification of all important species of prickly pear
- Treatment protocols/methods for each species of prickly pear
- Knowledge of the different biological agents for all species of prickly pear
- Knowledge of mass-rearing procedures, collection, distribution and evaluation techniques for the various biological control agents
- Knowledge of the background and extent of current biological control programs in various parts of the State

It is anticipated the transitional period for handing over all information, and training/field instructions will take 12-18 months. Local weeds officers are already busy, and any training etc would have to fit their existing schedules.

PROPOSAL:

1) That all property files in (52) Shires presently containing **less than 25 files** of be handed over to the relevant council weeds officer by **December 1995**. Section 7 of the Prickly Pear Act 1987 already delegates councils to operate under this Act;

2) That all property files in (17) Shires presently containing **25 to 100 files** be handed over to relevant council weeds officers by **June 1996**;

3) That the **balance of all property files** (involving 10 Shires) be handed over to relevant council weeds officers by **December 1996**;

4) That the various prickly pear species be categorised under the Noxious Weeds Act 1993 according to levels of infestation within each local government area. Categories to be discussed with each council as part of the changeover process.

5) That an assessment of additional funding requirements for Councils, in recognition of increased inspection and maintenance responsibilities, be made on an individual basis as part of the property information "handing-over" process. Recommendations to be then submitted to the Noxious Weeds Advisory Committee for consideration.

Acknowledgements:

Background/history items . . . . . V.H. Gray, G.E. Ryan, J.R. Hosking

PRICKLY PEAR IN NSW - AS RECORDED ON "CACTUS" DATABASE

Councils/No. of files		Councils/No. of files	
1	Albury ... 4	52	Lismore City ... 4
2	Ballina ... 13	53	Lithgow ... 0
3	Balranald ... 3	54	Liverpool ... 3
4	Barraba ... 32	55	Maclean ... 7
5	Baulkham Hills ... 2	56	Maitland City ... 16
6	Bega Valley ... 3	57	Manilla ... 38
7	Berrigan ... 0	58	Manly ... 0
8	Bingara ... 139	59	Merriwa ... 96
9	Blacktown City ... 0	60	Moree Plains ... 211
10	Blano ... 0	61	Mosman ... 0
11	Blue Mountains City ... 0	62	Mudgee ... 199
12	Bogan ... 4	63	Murrurundi ... 37
13	Bombala ... 0	64	Muswellbrook ... 98
14	Botany Municipal ... 2	65	Narrabri ... 57
15	Bourke ... 5	66	Narromine ... 11
16	Brewarrina ... 0	67	Newcastle ... 2
17	Broken Hill Barrier ... 4	68	North Sydney ... 1
18	Byron ... 0	69	Nundle ... 32
19	Cabonne ... 11	70	Nymboida ... 2
20	Camden ... 5	71	Goobang ... 4
21	Campbelltown ... 0	72	Parry ... 104
22	Cobar ... 8	73	Penrith ... 2
23	Coolah ... 116	74	Port Stephens ... 4
24	Coonabarabran ... 51	75	Randwick ... 0
25	Coonamble ... 121	76	Rylstone ... 41
26	Copmanhurst ... 4	77	Scone ... 86
27	Cowra ... 0	78	Severn ... 2
28	Dubbo City ... 34	79	Shellharbour ... 5
29	Dumaresq ... 2	80	Shoalhaven ... 116
30	Dungog ... 11	81	Singleton ... 116
31	Eurobodalla ... 7	82	Sutherland ... 1
32	Evans ... 53	83	Tamworth City ... 19
33	Jemalong ... 2	84	Tallaganda ... 22
34	Gilgandra ... 175	85	Tenterfield ... 36
35	Grafton ... 3	86	Tumut ... 0
36	Great Lakes ... 2	87	Tweed ... 1
37	Greater Cessnock ... 26	88	Uralla ... 17
38	Greater Taree ... 13	90	Wagga ... 0
39	Gundagai ... 0	91	Walgett ... 101
40	Gunnedah ... 45	92	Warren ... 8
41	Guyra ... 1	94	Waverley ... 2
42	Harden ... 0	95	Wellington ... 58
43	Hastings ... 2	96	Wentworth ... 4
44	Hawkesbury ... 6	97	Wingecarribee ... 1
45	Inverell ... 267	98	Woollahra ... 0
47	Kempsey ... 3	99	Wollondilly ... 8
48	Kiama ... 2	100	Wollongong City ... 3
49	Kogarah ... 0	101	Yallaroi Shire ... 80
50	Kyogle ... 6	102	Quirindi ... 23
51	Lachlan ... 0	103	West Wyalong ... 0

WATER HYACINTH IN THE HAWKESBURY - NEPEAN RIVER SYSTEM.

Geoff Keech
Sales Supervisor
Macspread Pty. Ltd.

Introduction

In April 1993, inspectors with Hawkesbury River County Council (HRCC) discovered a large infestation of Water hyacinth (*Eichhornia crassipes*) in the Nepean River extending for some 1.5 kilometres from McCanns Island (downstream of Penrith) to about Jacksons Lane.

A licence to apply herbicides to water was applied for from the Environmental Protection Authority, and was subsequently granted on 10th June 1993. Spraying commenced on the 23rd June and continued throughout the next 7 months.

At the end of January 1994, I returned from annual leave to find several urgent messages waiting for me to contact Graham Ingles, the Chief Weeds Officer at HRCC.

The resulting conversation revealed that a "large" infestation of water hyacinth was present in the river and it was causing some concern due to its increasing size despite the best efforts of County staff. Due to this concern Jim Quinn the Weed Biological Control Officer at Gosford was despatched to check it out.

The next day I received a fax saying "it has to be seen to be believed" and " I think you had better come down and have a look".

On the 14th of February I inspected the area with David Karlson, and discovered that the infestation had all but been controlled in the area it was first discovered, but had exploded downstream from Jacksons Lane to just above the bridge at North Richmond, a distance of 17 kilometres.

Large rafts were covering the entire width of the river in some places with floating plants moving further down stream towards Windsor. In total some 25 kilometres of river were infested to some degree.

Water hyacinth had not been reported in the river for about eleven or twelve years prior to 1993, and then not above an area 9 kilometres downstream of the source of the current infestation.

Source of the Infestation

The suspected source of the current infestation is a small dam hidden behind dense undergrowth at McCanns Island. Inspection of this area revealed dense growth of hyacinth, and it is thought that summer storms had flushed some of the contents into the river.

From this small outbreak, rapid growth promoted by eutrophic conditions in the river caused a rapid spread downstream. Hyacinth has the capability of doubling its size under ideal conditions every 7 to 10 days according to Dr. David Mitchell (pers. com), of the CSIRO Murray - Darling Freshwater Research Centre. Reports in Parsons and Cuthbertson (1992) and Sainty and Jacobs (1981), confirm this ability.

Why Control ?
Several elements of political, social and economic bases were recognised. There was a potential loss of part of the commercial fishing and oyster growing industry down stream of the infestation, some loss to agriculture through the fouling of pump inlets and restricted livestock access and a loss to the tourism industry should the infestation become impenetrable to navigation.

The possible loss of property such as bridges, fences, livestock and crops was taken into account as well as the loss of habitat and scenic value which in turn impacts on the local tourism industry.

Large masses of the plant would restrict recreational fishing, water skiing (such as the bridge to bridge event) and other boating and swimming activities. The political aspect of a combination of the Weeds Act and the community concern being divided over who was going to pay and the potential loss of the use of the river was played out in the local and state press, eventually bringing pressure onto the Government of the day to control the problem.

At this stage it is probably pertinent to describe water hyacinth and its properties as an explanation of its importance as a noxious weed in New South Wales.

Common Name : Water Hyacinth
Family : *Pontederiaceae*
Genus : *Eichhornia*
Species : *crassipes*

Physical Description - as described by both Sainty & Jacobs (1981) and Parsons & Cuthbertson (1992).

Water hyacinth is a lilly like plant in the Monocotyledon group of Angiosperms. The plant is normally a free floating stoloniferous perennial, growing to 2 metres tall under ideal conditions and may become attached to the bottom or grow in saturated soil at the edge of the water body (personal observation).

There may be two different forms of the plant depending on growth conditions and density of the population. Where space is available, the leaves are basal with spongy inflated petioles used for flotation. The leaf blades in this form are rounded and curved upwards with veins more or less parallel, following the curvature of the leaf.

The second form occurs where space is restricted and dense growth results. The petioles of this form are long and thin showing few flotation devices, and the leaves become more pointed. This was the form mostly found in the infestation in February 1993 with much of the infestation growing up to 1.5 to 2 metres above the water.

Flowers are bluish purple with six petals, borne in spikes to about 15 cm long. The upper petal has a yellow blotch in the centre surrounded by a darker purple. Each individual flower lasts only about 2 to 3 days. The roots are black to purple and range in length according to available nutrients, water depth and the age of the plant. Some I have observed have exceeded a metre in length.

Ecology - from Sainty & Jacobs (1981) and Parsons & Cuthbertson (1992). This plant reproduces by both seed, and vegetatively by stolons rooting at the nodes and forming daughter plants.

Seeds germinate in the spring (the Hawkesbury infestation germinated all year round), and under ideal temperature and nutrient conditions, will double in size every 7 to 10 days and may flower when only three weeks old.

Flowering occurs over the summer months and when each spike has completed flowering, it bends over into the water. Seeds are shed in about 18 days and may germinate within 3 days or lay dormant in the mud for 15 to 20 years. Winter frosts will cause the weeds to die off, leaving dormant crowns to regrow in the spring. Its habit is still or slow moving freshwater streams or impoundments.

It does not survive in sea strength salinity and saline levels of around 4000 ppm will limit growth after some months, eventually killing the plant. The plant also needs relatively high nutrient levels to flourish and has been observed to die when placed in clean water.

It could be said that the incidence of the explosive growth of hyacinth in the Hawkesbury - Nepean is a messenger telling us of the real problem, the health of the river. Mature plants can weigh up to 400 tonnes per hectare and contain up to 95% water.

Origin and Distribution - from Sainty & Jacobs and Parsons & Cuthbertson.
Eichhornia crassipes is a native of the Amazon Basin in South America, it has now spread to all tropical and subtropical countries in the world. The first reports of water hyacinth in Australia came from NSW and Qld in about 1895, and by the early 1900's had spread along the east coast of Qld and the north coast of NSW.

Reports of infestations have been made from all states of Australia except Tasmania, where it only occurs as an aquarium plant. In NSW it is considered as abundant in coastal dams and waterways from Kiama north.

Impact on the Environment - from Sainty & Jacobs and Parsons & Cuthbertson.
When allowed to grow unchecked this plant has devastated waterways and cost billions of dollars in lost production in agriculture. It dominates the waterways of over fifty countries and is credited with the annual loss of paddy rice in the Indian state of West Bengal to the value of 110,00 rupees, as well as the loss of 45 million kilograms of fish.

The floating plants obstruct the movement of water, prevent the entry of sunlight, and may remove the oxygen from it, making the area unsuitable for aquatic life and creating faunal deserts beneath dense mats. If extensive areas are infested, this effect could cause localised extinctions of some species.

Australian native fish have a dislike for total surface cover of weed and tend to avoid such areas, David Mitchell (pers. com.). Valuable breeding sites may be lost and alien species such as the European carp may flourish, as they spawn on the root systems of floating plants such as *E. crassipes*.

The slowing of water movement has other effects also, such as increased siltation which can alter the nature of the bed of the waterway from clean gravel to mud, which

in turn may effect the species diversity through habitat loss and/or alter habitats precluding breeding.

As large rafts of the weed build up in narrow sections of waterways or on structures, water flow may be diverted to areas not normally inundated during flood periods. This can cause erosion of the banks and nearby flats, adding to the siltation problem.

Where the entire surface of the water body is covered, the bird life leaves the area (personal observation), causing a loss of species diversity and maybe upsetting the breeding activities of species reliant on the local habitat. Should the area remain covered for an extended period, permanent loss of some species may occur.

Increased water loss through evapotranspiration has been reported (up to 10% of the normal flow in the Nile River) in Parsons & Cuthbertson (1992). Obviously if an infestation reaches this level in this, the driest continent in the world, there are several other ramifications.

For example reduced water quantities available for irrigation, also restriction of navigation and recreation, endangering structures and settled areas and the creation of stagnant pools where mosquitos may breed causing health problems through the spread of disease.

Water hyacinth can have a beneficial impact on the environment through nutrient removal from the water. It is a very efficient remover of not only nutrients, but also pesticides, radioactive material and heavy metals. The problem is what to do with the hyacinth when it has done all of this. If left to die and decompose in the water, all the elements it has adsorbed will be re released.

If toxic or radioactive materials have been absorbed, the plant could not be harvested and used for compost or stock feed, there is however some potential to produce methane if the supply is plentiful and harvesting is cheap enough. Water quality is reduced through the injection of hydrogen sulfide, making livestock and domestic supplies odorous and bad tasting.

Control Methods

There are several options open for the control of water hyacinth and each one may be best suited to a particular situation or be part of a long term management program.

Integrated pest management is obviously going to be more environmentally friendly and most likely more successful in the long term. The methods chosen for control will reflect the urgency or the potential of the infestation to spread .

The following methods were investigated as options for the Hawkesbury infestation :-

Physical Removal

This method of control is very effective for small areas or where there is a plentiful supply of cheap labour. The plant is simply removed from the water and allowed to dry out, it can then be used as a compost or stock feed. Not an option in this situation due to the depth of the water and the size of the infestation.

Mechanical Harvesting

For large areas with sufficient depth of water and absence of snags and rocks to allow the navigation of machinery, this method has potential, however the costs associated with the operation and disposal of the harvested material proved prohibitive. This method is an alternative if money is plentiful or the area is extremely sensitive to the use of herbicides.

Biological Control

This is the method of choice where immediate results are not required. The introduction of biological control agents can take up to 10 years to bear fruit. The success of bio agents has been high in many countries but not all.

This success rate is limited by climate, for example in NSW Parsons & Cuthbertson state that very few successful establishments of the weevil *Neochetina eichhorniae* have occurred south of Coffs Harbour. There are very few colonies of *E. bruchi* surviving in cooler regions and their spread has also been slow in this area.

The moth *Sameodes albigutallis* has not been entirely successful on its own, however it is hoped that together with the weevils and some naturally occurring pathogens, a synergistic effect may result. Again because of the need to quickly clear the infestation to prevent the spread down stream and remove the potential danger posed to the bridges on the river, bio control was not an option.

Chemical Control

Because of the necessity to quickly clear the infestation, this was the method chosen. There are several herbicides that are effective in the control of hyacinth, not all of these are registered in Australia.

The product of choice was diquat used at the rate of 400 ml per 100 litres of water, because of its cost effectiveness and safety to the environment. It is a non residual herbicide which is safe to aquatic vertebrates and invertebrates, breaks down rapidly in ultra violet light or is bound tightly to clay particles and not re released, except to be broken down by micro organisms into naturally occurring elements.

This product does pose a threat to the operator, but with proper precautions is safe to use.

Care has to be taken with the control of large areas in short periods of time, as the rotting plants may deoxygenate the water causing problems for aquatic life.

Managerial Control

We all know the adage, "prevention is better than cure", and this is also the case with weed invasion. Water hyacinth will not flourish in low nutrient conditions, so the management and reduction of nutrient levels in effluent is essential.

The exclusion from entry of propagules will also keep an area clean. Manipulation of water levels where possible has proven to be successful, and was one of the major elements of the control program in the Gingham Watercourse west of Moree in northern NSW. The regular wetting and drying

of the area stimulated germinations effectively reducing the seed bank and controlling the plants. this method can be controversial if wetlands are involved.

"Operation Hyacinth", Water Hyacinth Control in the Hawkesbury - Nepean River

Once the furore had taken hold, quick action was called for. A meeting was convened through the Hawkesbury - Nepean Catchment Management Trust, involving representatives from NSW Agriculture, Hawkesbury River County Council, HNCM Trust, Conservation and Land Management, Dept. Water Resources, Water Board, Environment Protection Authority and several independent experts including Geoff Sainty of Sainty and Associates, Surrey Jacobs of the Royal Botanic Gardens and Dr. David Mitchell from the CSIRO Murray - Darling Freshwater Research Centre.

The meeting resolved to seek immediate funding from the government to control the problem, and that a chemical control option using diquat as the preferred herbicide be adopted. A video of the problem as it was at that stage was produced and a second filming of the results was also shot.

As already stated, the herbicide diquat was chosen as being the most suitable for the situation. The main problem encountered was in application. The hover craft operated by HRCC found difficulty in penetrating the dense mats of hyacinth and little headway was made by spraying the edges and waiting for them to sink, as the growth was nearly as fast as the control. One large area below the Hawkesbury Lookout proved to be impossible to enter.

Aerial application was ruled out due to the large number of power lines crossing the river and the increased risk of off target damage due to herbicide drift, so the Seiga Tortoise which was successfully used at Moree was imported and was able to climb over the raft, enabling a large area to be controlled relatively quickly.

The plan of attack involved the purchase of a second hover craft and the dissecting of the river into management areas. The infestation was attacked from both ends, and easy to access areas were controlled first. The main action at the down stream end was to eradicate the plant up as far as a naturally occurring barrier at Tilmunda Quarry, this allowed work to continue upstream (which caused the break up of some of the rafts) without the need for constant mopping up operations at the bottom end. This segmented control program prevented large masses of decaying plants forming in any one area and any subsequent deoxygenation of the water.

The dissolved oxygen levels in the river were monitored regularly by the EPA and did not fall below acceptable levels. During the whole operation, no adverse effects such as fish kills or off target damage to desirable species was noted, and shortly after areas were cleared, waterfowl were seen back in the area feeding normally.

Throughout the operation, regular reporting to NSW Agriculture, the Minister for Agriculture, the HNCM Trust and all other interested parties was undertaken. A public meeting was held for local landholders adjoining the river, and general agreement for the support of the action being taken was gained.

The Aftermath

The HRCC is now well equipped to assist in the control of any major aquatic weed outbreak. They possess 2 hovercraft equipped with spraying gear, the Seiga Tortoise

(an all terrain vehicle currently being upgraded and equipped), aluminium boats, ground rigs, communication equipment and the necessary expertise to operate all of these.

The management of this infestation is continuing today, and will have to continue for many years to come until the seed bank is exhausted. Germinations have continued all year round, contrary to the popular belief that they would only occur in the spring and warmer months. This has meant the need for constant vigilance by HRCC, and an added expenditure which may need to be addressed by financing authorities.

A plan to manage all the infestations in water bodies adjoining the river and with potential to reinfest the river with mature plants has had to be formulated. So as a necessary activity a base plan for the management of aquatic noxious weeds in the Sydney Basin was developed and should be released shortly.

This plan can be adapted to suit almost any infestation or weed problem and is being tested out with the current infestation of alligator weed in the same river system. There was a need to create a public awareness about water hyacinth and its associated problems, so a new video has been produced.

The major stumbling block in the war against noxious weeds is the lack of understanding by landholders regarding the problems caused by the presence of the weed and just who is responsible for control on private land.

The fight against water Hyacinth must continue, this plant in spite of its beautiful flower, remains as the largest threat to Australia's inland waterways.

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PRODUCT UPDATE FROM MONSANTO AUSTRALIA

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Bendigo Victoria

Trounce Brush Pack

Trounce Brush-Pack is a new brushweed herbicide developed Monsanto. Trounce Brush-Pack is registered for the control of Blackberry, Bracken, Gorse, Sweet briar, Lantana and St John's Wort. many more weeds will be added to the label over the next few years.

Granular Product

Trounce Brush-Pack is granular product packaged in a waterproof, foil-lined measure pack. Each pre-measured sachet makes up 100 litres of spray mix.

Trounce Brush-Pack is easy to store, transport and use. Any spills can be swept up and there are no drums to rinse out.

Trounce Brush-Pack is non volatile and there is no smell when mixing or applying this product. This means there are no seasonal ore regional use restrictions near sensitive crops such as tobacco and vines.

Dual Mode of Action

Once in the plant, Trounce Brush-Pack works in two separate ways.

1. One component stops protein production and starves the plant. It does not breakdown in the plant, but is used up as it substitutes for an enzyme a key biochemical pathway, therefor it works over a long period of time.

2. The other component travels rapidly to the growing tips and stops cell division. It quickly breaks down int he plant and is gone within 2-3 months after spraying.

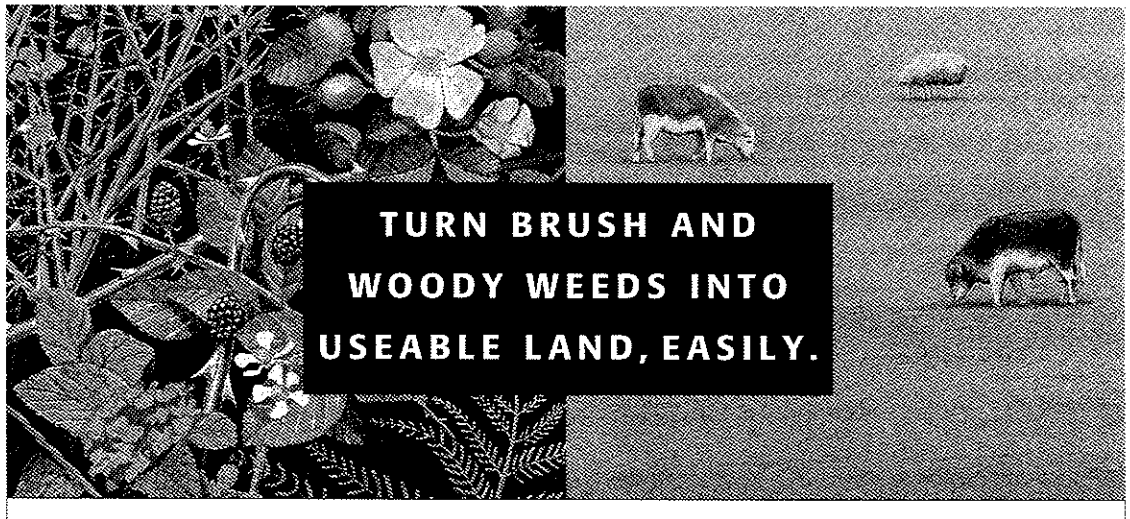
This dual mode of action works to give the most reliable, long term brushweed control.

Unique formulation

The unique formulation, developed by Monsanto's research chemists in Australia and the US, provides optimum stability of Trounce Brush-Pack in the pack and in the spray tank.

Handgun application of Trounce Brush-Pack

Thorough spray coverage of all foliage and stems is critical. Use a pressure for grater than 100kPa to assist bush penetration. hand-gun nozzle tips of size No. 6 or greater are recommended for bushes up to 2 metres high. Use a No. 8 tip and a higher pressure for bushes larger than 2 metres high. Use a wide cone setting as much as possible.



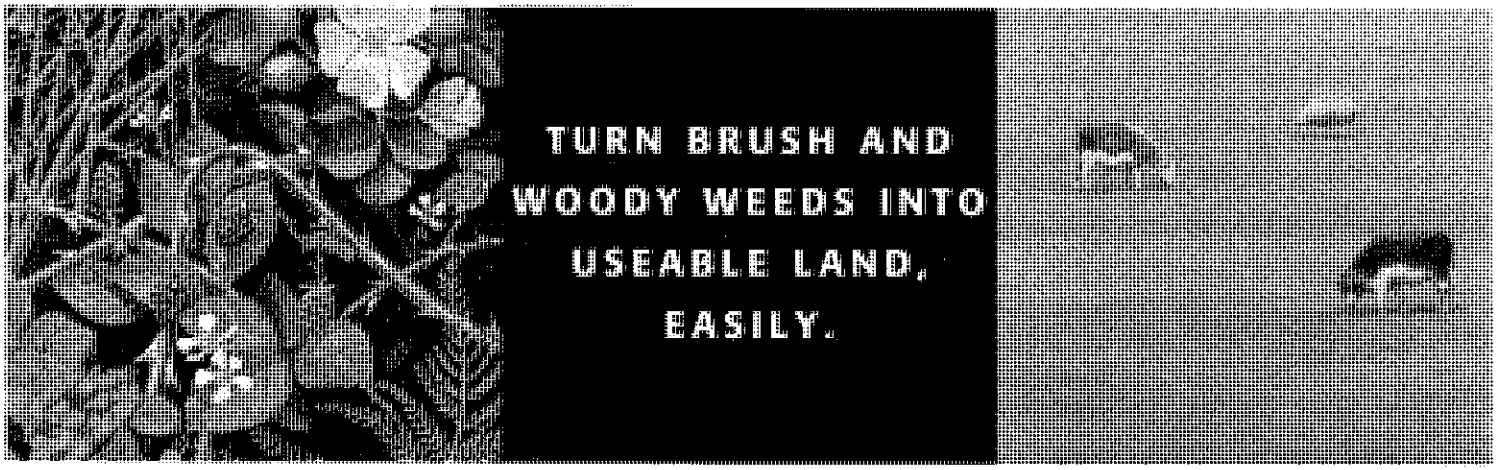
One premeasured pack of Trounce Brush-Pack makes 100 litres of woody weed killing mix.
So get your land back from brush and woody weeds, easily, just visit your nearest supplier of Trounce Brush-Pack.

Dealer name here.

TROUNCE® BRUSH-PACK™ HERBICIDE BY Monsanto

GET YOUR LAND BACK. EASY.

CCSO&M MON 4839B



CCSO&M MON 4839C

One premeasured pack of Trounce Brush -Pack makes 100 litres of woody weed killing mix.
So get your land back from brush woody and weeds, easily, just visit your nearest supplier of Trounce Brush-Pack.

Dealer name here.

TROUNCE® BRUSH-PACK™ HERBICIDE BY Monsanto

GET YOUR LAND BACK. EASY.

treat bushes form all sides. Spray to thoroughly wet all the foliage and stems. Use an even side-to -side movement of the spray, working from the particular attention to runners and the top and middle of large bushes, as un-sprayed foliage may not be controlled.

Results

Full brownout should occur 3 to 6 months after treatment. This is dependent on the species and the time of year as brownout is slower form late season applications.

Results on blackberry with Trounce Brush-Pack and Pulse Penetrant (0.1%) applied by handgun are equal or superior to any other of the products on the market.

Recent trials on Bracken show good results form Trounce Brush-Pack at 7 to 9 packs per hectare plus Pulse at 0.2% when applied by boom.

Surfactant Addition

Pulse Penetrant is the only surfactant recommended for the use with Trounce Brush Pack. It has proven to give the best results over the widest range of brushweeds compared to other surfactants OR oils.

The unique formulation of Trounce Brush-Pack eliminates the antagonism observed between Pulse and general purpose surfactants. This allows the reduction of the Pulse rate to 100 ml/100 litres of water, half the normal rate (for boom application, still use 200 ml/100L).

Non-Hazardous

Trounce Brush-Pack is non-hazardous product, with an Dermal LD50 of greater than 5000 mg/kg. When handling the concentrate, only elbow length gloves and protective glasses need be worn. When spraying, operators need only wear cotton overalls and wash hands, arms and face thoroughly with soap and water after use for before eating, drinking or smoking.

Post-Spraying management

There is no stock withholding restriction with Trounce Brush-Pack. There is no souring of the grass, in fact, Trounce Brush-Pack makes grass sweeter and more palatable. The stock push into the brushweeds to graze, which helps trample down the bush.

Bushes treated with Trounce Brush-Pack can be disturbed form one month after treatment.

Establishment of new species

Expect some soil residual activity with Trounce Brush-Pack.

Trounce Brush-Pack may inhibit the establishment of species sown in treated areas for 3-6 months after treatment.

The rate of breakdown of Trounce Brush-Pack is fastest at high temperatures where there is good soil moisture and low pH soils. Expect a longer residual when treating in the late autumn in cooler conditions.

Tolerance of the species sown should be determined on a small scaled, before sowing into larger areas.

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WHAT IS STRESS?

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Many people describe their job as stressful. This is supported by the number people leaving the work force each year with a stress related illness. However, stress comes not just from work but also from other life events (such as parenthood or divorce). Stress is a lifelong human condition and can be managed if it is understood. Knowledge of its effects and preparation, through training in stress management strategies, can help master the uncomfortable reactions. What follows is a description of stress, what it is and how it affects our physiology, the way we think and how we behave. Next month there will be some stress management strategies.

What is stress?

There are many definitions. Some are:

- A response to a perceived threat
- A physical and psychological response to any demand
- A state of psychological and physical arousal
- The stage where 'wear and tear' occurs to the individual following exposure to anxiety producing events. Some believe that this wear and tear will show up in a 'target organ'. A target organ is that one which is most likely to signal that stress is getting out of hand. For example, for some people a migraine is a clue, for others it may be other body aches, and for still others it may be digestive problems.
- Thinking about and dwelling on events that could be called 'stressful'

The common element in all these definitions is that stress is a RESPONSE to something in the environment known as a STRESSOR. When the environment changes so does the body physiology. This is an inbuilt human mechanism designed to protect people and to help them deal with the challenges of the stressor. This response has evolved as part of being human since primitive man. When caveman was challenged it was probably most frequently a physical challenge created by the demands of hunting food, or escaping from predators. He or she needed to be able to think quickly, sum up the danger and make a decision about fighting or running away. If the latter was chosen the body needed energy and fuel to run as well as sweat to keep the body from overheating. If a wound was received then the body had an answer - the blood clotting ability increased so the victim was less likely to bleed to death.

Thus the body changes following stress increase concentration and mobilise the body physiology so that it can meet the demands of sudden physical activity, such as running away or fighting off a predator. For officers today the challenge may come

when called to a violent or dangerous event. Then the responses are helpful, increasing concentration and giving the body the extra energy needed to cope with what must be done. But challenges also can come in other ways such as being paraded in front of the boss, anticipating a painful dental appointment or even perhaps worrying about being attractive enough to find a mate. In those situations fighting or running is not appropriate and the changes to the body physiology do not help meet the challenge.

The trigger that sets the stress reaction going can be produced by environmental factors (those things surrounding us, which can be wide ranging such as sights and sounds at a fatal through to simpler things such as overcrowding in the office); by psychosocial factors (those things which are interpersonal, from being misjudged or lack of appreciation from others through to everyday family relationships); personal factors (these are the emotional and thinking parts inside us - such as the inability to say "no", guilt feelings or even setting excessively high standards).

Body physiology, performance and stress

The stress or 'Fight and Flight' response has evolved to help humans deal with challenges. It is so effective that at times people continue to strive even though the body is at breakdown point. There are examples of athletes running until exhaustion or footballers playing on with unrecognised injuries because the pain has been masked by the body's response to the challenge. The normal signs, such as pain, that tell us when it is time to quit are over-ridden and people continue to try to perform even beyond the comfort zone. However, when people are very stressed the quality of their work goes down. They tend not to be as effective in the job or at home. Often they become so concerned with their own troubles that they do not communicate well with others and this can lead to poor family relations.

When humans are challenged and they recognise the danger then the body instinctively moves into the 'Fight or Flight' response. People who have been in very dangerous situations will recognise this response. Under such stress Adrenalin and Noradrenaline are released into the blood stream during the fight and flight response. Adrenocorticotropic Hormone (ACTH) is released and, in turn, stimulates the release of powerful chemicals called catecholamines. These prepare the body to deal with stress.

Among other things, the response includes:

- The brain becomes more alert to take in more messages
- Muscles tighten
- Pupils dilate to take in more light
- Breathing rate increases
- Heart rate increases
- Blood pressure increases
- Blood clotting ability changes
- Blood is diverted to the muscles
- Cholesterol and triglyceride levels increase rapidly
- The liver produces glucose, the fuel for the muscles
- Protein levels increase dramatically - for white blood cells and antibodies
- Immune responses change
- Sweating increases to cool the body and saliva decreases.

The relaxation response is the opposite of the Fight or Flight response. It involves other changes in the body. These include:

- Breathing slows and becomes shallower
- Heart rate decreases
- Sweating decreases
- Blood pressure drops
- Lower muscle tension
- Changes in the secretion of hormones
- Changes in brain wave activity.

Make the most of stress - Recognise good stress and train in preparation for distress

Not all stress is destructive. When athletes strive to break an Olympic record they experience stress, but this stress can be experienced as exhilaration. A challenging job may be rewarding even though it is also be stressful. Getting married is one of the more stressful possible events in our lives yet it is a commitment many are happy to make. Many other life events have been related to raised stress levels. In fact, having no stress at all can become extremely disturbing, even stressful. It is stress or challenge which mobilises the body to produce various chemicals that help us cope with that challenge. These chemicals also help us to feel 'alive'. Many call this 'the adrenalin surge'. Hans Selye identified this productive side of stress and called it Eustress as distinct from the destructive side of stress which he called Distress.

Eustress is often experienced by people like police at the close of a dangerous and challenging job, which has ended well. They may be talking excitedly about the event - going over and over details that were rewarding. Or sports champions may behave the same way after winning a demanding event. Sometimes it can take many hours to 'come down' from that sort of excitement.

There is another way of looking at good stress levels and this is to work towards what has been called 'optimal' stress. This means to work well even though stress levels are moderately high. We all need some stress to perform. Without it there would be no change, growth or productivity. Some level of stress provides stimulation and motivation. The only person who has no stress is a dead one. To cope with stress people need to find a balance and to fit the level of stress to current life demands. This level has been called the 'comfort zone'. It is at this level, where stress is neither too high nor too low for the challenge that people perform best. At this level stress is helpful and not destructive. Finding the comfort zone is essential for people with a demanding job and other life style demands. This comfort zone differs from person to person and from task to task. For example:

- Difficult tasks are performed better with low background life stress levels
- Boring tasks can be satisfactorily performed under greater stress conditions

Preparation and training for a task can help people perform well even under high levels of stress. It is important to have the right skills to do a job. Some of these skills are physical and others mental. Workers often spend a lot of time training to increase job skills. They should also practice the skills needed to keep them in the stress comfort zone. People can raise the level of stress they find tolerable (or increase their comfort zone) by working at it. Like other job skills this takes effort and practice.

Personal management strategies are important. These strategies include self monitoring of stress levels, practising regular relaxation, developing a realistic and positive outlook, maintaining a healthy lifestyle and ensuring appropriate fitness levels. It is very hard to bring into play psychological self management strategies when stress is severe unless they have been practised before hand. The key to managing is to develop personal coping 'fitness' through regular practice in the same way as physical fitness is fostered through a regular exercise program.

Thoughts and stress

One aspect that is often overlooked is the 'thinking' part of stress. Stress will affect people in different ways depending on how they view a potentially stressful incident. For instance, if a woman was assaulted in a park, she may have great reluctance to venture into parks again. What was previously a pleasant green space has become identified in her mind as a threatening situation. These interpretations of threat can change as new information comes to hand. David Sobel, who is a well known psychologist, in 1988 wrote the following description of an experience he had one night:

> *"I was aroused, fearful. Eyes wide open. Muscles tense. Heart pounding. What could the sound be? Did I lock the door? A burglar? A squirrel? Was the roof falling? With each thought I was prepared to act differently. Then I remembered that a friend of mine from out of town had asked to stay over. He must have noticed that I was asleep and then let himself in. Once I realised what had happened, I went back to sleep."*

Three elements are important in helping us interpret and interact with our world. These are the environment (what we see, hear, smell, touch), our feelings or moods, and how we interpret or think about things. Our world view changes because of these three elements. To summarise:

ENVIRONMENT - we experience positive, negative or neutral events

MOOD - some moods have a strong biological base (eg a depressive illness) but other feelings can be modified by our thoughts.

THOUGHTS - we interpret experiences with a series of thoughts that continually flow through the mind. This is known as 'self talk'.

Experiences must be given meaning before we respond. If something in our environment is neutral (has no relevance to us) we will ignore it and rapidly forget that it ever happened. Important events are remembered - usually with some feelings attached to that memory.

People attempt to make sense of, and understand the world in which they live. In some ways humans operate continuously like scientists. They take in new information and fit it against earlier experiences. For example, if you develop a sore throat and one of your workmates confesses he too has had a sore throat, you will probably ask him, "how long did yours last?" "what did you do to help it go away?" Alternatively, you may think about how your throat feels and try to remember if you have suffered in a similar way before; you may then try to recall past remedies that have helped you, or those you have recently seen advertised in the papers or on television. The aim of all

of this is to help you, the scientist, understand your condition and produce actions which will lead to better health.

There are two components to the way we try to improve our understanding and they are Recall and Interpretation.

Recall: Humans are 'survivors' and part of the survival mechanism involves vividly recalling events which are potentially dangerous. Such memories may be said to be 'hard wired' into our brains. This 'hard wiring' makes it difficult to forget. It ensures that we do not enter into similar dangerous situations again, or if we do then we are prepared.

Interpretation: To be significant an event must have a meaning for us. The personal meaning of an event may change the reaction - what is seen as an exciting challenge for some may be interpreted as exceptionally dangerous by others. Working out the meaning of an event is additionally difficult because states of emotional arousal are somewhat similar for different emotions. Then other clues are used based on what else is happening. This means that sometimes people mistake the type of arousal and misinterpret the feelings associated with those body sensations. Research has shown two good examples of body physiology 'fooling' people about the nature of the emotion:

Films and aggression: Using controlled research conditions, people viewed films under chemically induced different states of arousal. The results showed that the artificial chemical arousal influenced interpretation of the film action.

Fear and love: Young college men were interviewed by an attractive female research assistant under conditions which produced an emotional arousal - fear. The interview was conducted on a suspension bridge over a deep ravine. Many of the young men misinterpreted the fear arousal for sexual attraction, and asked the research assistant for a date. The effect was quite different when the same research assistant interviewed young men in an ordinary way.

Cumulative stress When a stressful event occurs in life it impacts on a person who has experienced problems before. Some will have been overcome and others will be current. These include simple everyday concerns, such as having to pay for repairs to the car, children's health problems, job worries and so on. This load of prior stressors will impact on the person's psychological and physical constitution. If it becomes excessive, both systems are under strain. With multiple stressors the limit is close to being reached! The last straw is about to be added to the bundle! Under those circumstances a small extra stressor can lead to a severe reaction. It is not the small stressor which produces the breakdown, but rather the total amount of cumulative stress.

But it is not all bad news. Sometimes past experiences can help, such as when we recognise that the new stress is similar to one that has been mastered before. In those instances the 'self talk' will probably be something like, "This is tough, but I've done it before and can do it again". Positive self talk can help motivate to meet the challenge.

One factor which influences coping strategies is the continual interplay of thoughts, behaviours and body changes. This interplay can begin slowly or suddenly when the impact of a stressor adds to the total stress level (or challenges our psychological

constitution). Life is a bit like a game and the Stress Game example shows how stress can mount up with body reactions, thoughts and behaviours all interacting to challenge coping.

Of course the key to coping and managing is to cut the interactive build up between bodily effects, thoughts and ineffective behaviours. The feedback loop that tells us that we are not coping must be cut and stress management strategies implemented as soon as possible. Using relaxation and problem solving strategies can break the cycle of increasing stress and help us cope.

THE STRESS GAME

Start at **GO** [here you have a handful of cards that say:
Married with children;
Mother in law is visiting;
Own an old car;
Working and studying at night;
Just recovering from Flu

You draw a new card that says -
Introduce ******STRESSOR******

Your handful of cards plus the new card mean a penalty - a torrent of bodily reactions
BODILY EFFECTS
Fight and Flight Response
Shallow Breathing
Pounding heart
Tense muscles
Digestive Problems
Sleep disturbance
Fatigue

This gives you the entitlement to another card. This is a Thought Change card
THOUGHTS
You feel upset
Angry
Fearful
Have self doubts
Have repeated 'danger' thoughts
Worry
Think about y our health problems a lot

With this hand of cards you are automatically issued with a Behaviour Change card
BEHAVIOURS
You try to escape
You are indecisive
You become more irritable or aggressive
You show poor judgement
You are less efficient than before
You avoid things that are difficult
You drink and smoke more

AS YOUR BEHAVIOURS CHANGE, YOU NOTICE THIS AND YOUR THOUGHTS BECOME MORE UPSET, AND YOUR BODY CHANGES GET WORSE AS YOU GET MORE UPSET. IT ALL GOES ROUND AND ROUND.

IS ANYBODY ELSE GOING TO GET A TURN IN THIS GAME?

Is there an end to the Stress Game? What to do?

Luckily, if you have a *Relaxation* card or a *Sensible Self Talk* and *Problem Solving* card you can cut a lot of this short. You can reduce the body arousal with relaxation. You can use sensible self-talk to reduce the upsetting thoughts. This, combined with realistic problem solving strategies will lead to a reduction in ineffective behaviour.

More about that in the next issue.

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STRESS MANAGEMENT STRATEGIES

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GOOD STRESS MANAGEMENT IS
KNOWING - RECOGNISING - DEALING WITH IT

The steps are simple

(1) Know and understand what the stress response is
(2) Recognise that the normal body response can feel strange, but that doesn't mean you are going crazy
(3) Deal with: the body response, the upsetting thoughts, the non-productive behaviours and the upsetting feelings.

Managing by knowing, recognising and doing

Managing stress has three elements - knowing, recognising and dealing with. People need to know what usually happens to the human body, mind and feelings during stress. The effects of sudden or acute stress (such as an emergency at work) will be different to that of a long ongoing stressful situation (such as an unhappy marriage). In either case if a person is armed with knowledge of the effects, they can self monitor in order to recognise the stress levels within themselves. This is an important key, for if stress levels can be recognised and dealt with while still at lower levels coping is much easier.

Simply knowing the normal effects of the fight and flight response has helped many people realise that they were not 'losing it'. To know that such body reactions as dry mouth, sweating or time distortion during an incident were part of that response has helped them to manage stress after a challenging experience. These are usually acute stressors with a sudden onset and limited in time. It is more difficult to recognise stress with a slow onset which continues over a long time. The body changes are gradual with the slow build up making them almost imperceptible.

Recognising - Signs that stress is a problem

The body changes produced during the fight or flight response are normal and will last for a short period of time. For example, if a door bangs behind someone they may be startled and have a rapid heartbeat for 10 minutes or so, but if involved in a violent confrontation the arousal will last much longer. Thus the exact period will depend on the event and the person's understanding of what happened. In some circumstances it is normal for it to last for any time between a couple of hours to three or four days. Eventually, over time the changes will slowly reduce and the body will return to its previous state. With cumulative stress or burnout a person is experiencing stress over a long period of time and the changes are more likely to become entrenched. Then the body may not so readily return to healthy functioning.

Everyone has some of the following symptoms from time to time. They are a problem only if they are persistent and are interfering with normal daily living. Typical stress problems reported by people are

feeling tense or anxious sleep problems (including difficulty falling asleep or frequent
waking and sometimes vivid unpleasant dreams)
irritability
poor concentration
frequent headaches
increased alcohol consumption
changes in sexual functioning
feeling either numb or miserable and depressed
body tension such as a tightening in the back of the neck or forehead

Stress can also change the immune systems functioning and sometimes people suffering from stress will have many infections that they have difficulty fighting off. If these are happening with you and it has been going on for some time, then it is time for you to implement some simple stress management practices.

Doing - strategies for tackling stress reactions

Exercise

One strategy that will help both forms of stress is exercise. This is because it turns around the fight or flight response and resets the body to more normal everyday functioning. It is important to find some form of regular exercise that suits you and before beginning any exercise regime to have a health check. It is dangerous to put a strain on body systems that are not prepared for that level of challenge. It is also important to realise that exercise does not have to be extremely vigorous to be helpful. Walking is an excellent way to keep fit.

Not everyone enjoys vigorous exercise. Although many people do prefer to be active there are a few who find quieter past times more to their taste. Some people find that the best way to unwind is to slow down and enjoy some passive activity, such as listening to music or reading. This group of people will also be more likely to be successful in using meditation or progressive relaxation to counter stress. Whereas those who are happiest 'working out' physically are likely to be impatient or uncomfortable with the slower activities such as meditation.

Relaxation

One form of relaxation which can be practised very easily is based on slow breathing. When humans are stressed or worried they tend to sigh. The slow breathing relaxation is something like sighing. Dr. George S. Everly developed the following exercise which he called "Calming Down". He believed it was an effective and quick way to calm down in the face of a stressful situation.

The procedure is as follows:

STEP 1 - Assume a comfortable position. Rest your left hand (palm down) on top of your abdomen, placing it over the top of your navel. Now place your right hand so that it comfortably rests on your left. Your eyes should remain open.

STEP 2 - Imagine a hollow pouch lying internally beneath the point at which your hands are resting. Begin to inhale through your nose. As you inhale, imagine that the air is entering through your nose and descending to fill that internal pouch. Your hands will rise as you fill the pouch with air. As you continue to inhale, imagine the pouch being filled to the top. Your rib cage and upper chest will continue the wave-like rise that was begun at your navel. The total length of your inhalation should be three seconds for the first week or so, then lengthening to four or five seconds as you progress in skill development.

STEP 3 - Slowly begin to exhale, breathing out in a sighing breath through your mouth - to empty the pouch. As you do, repeat to yourself the phrase "My body is calm". As you exhale, you will feel your raised abdomen and chest recede.

STEP 4 - Repeat this exercise twice in succession. Then continue to breathe normally for five to ten successive breath cycles, but be sure to emphasise the expiration of each breath as the point of relaxation. Then you may repeat the entire process again - two deep breaths followed by five to ten normal breaths during which you concentrate on releasing any stored tension on expiration. Should you begin to feel light-headed or should you experience any discomfort, stop at that point.

Practice this exercise daily. Make it a ritual in the morning, afternoon and evening as well as during stressful situations. When you are comfortable doing this omit step 1. Once you have trained yourself to relax you can do this exercise quietly while in traffic, before an interview or even while shopping. Your body will be conditioned to respond and should relax quickly.

Progressive relaxation takes longer and you need to be by yourself and able to find a relaxing position. In this type of relaxation you begin by tensing some part of your body. You might begin by making a tight fist with your right hand. You hold that tension for about 5 seconds and then let it go. You allow your hand to relax. You should, in your mind, tune into the messages coming from your now relaxed hand and notice the difference between body tension and relaxation. This pause to tune into your body allows you to not only notice any areas of tension, but also to contrast feelings of relaxation and tension. This feeling of relaxation is what you are aiming to achieve throughout your body. It is helpful again to link breathing out with a self instruction such as "My body is relaxed".

The next step is to slowly move through other parts of the body - arms shoulders, neck, forehead and face, abdomen, thighs, lower legs and feet. The whole procedure will probably take about 20 to 30 minutes. As you progress you may notice a feeling of warmth in your body. This is a sign that you are relaxing more and more.

If you have difficulty in working through these stages on your own you may be able to purchase a commercial relaxation tape to guide you through the process.

Meditation is another way to concentrate the mind and relax the body. Courses in meditation are offered through various organisations. It is best learned with someone present to train you in the technique. However, there are some relaxing audio and video tapes which have gentle music, the sound of waves or images of coral reefs which go part of the way towards calming the mind and meditating.

Try to stop pointless worrying - begin problem solving

Often people find it difficult to stop worrying about problems that may never occur. This usually starts with some self talk that says "What if ....." A lot of energy can be wasted worrying about things that never happen. This diverts energy and reduces realistic problem solving ability. It is sensible to think about something if it is a real threat and if you can do something about it. This is problem solving. The steps are simple:

(1) You need to work out what are the facts surrounding your problem

(2) Examine the options on offer to you. Some or all options may not be what you had hoped for. In fact, some of them may be unpleasant. Not every dilemma we meet in life can have a happy outcome. During this stage you may find it helpful to talk things over with your partner or a friend. But remember, it is your problem and the solution you choose must fit you, your needs, beliefs and your lifestyle. If you take notice of someone who says, "What I would do is ...." then you are likely to end up selecting an option which does not fit your lifestyle but fits theirs.

(3) Having selected an option then you must work out how best to achieve your goal. You may need extra skills or time to achieve this. But at least you have stopped pointless worrying and are setting off to achieve your goal.

Part of your problem solving may require you to organise and plan your day better, build better social support networks, or you may decide you need to work on conflict resolution. Taking time to develop these skills will pay off in the long run.

Stop worrying about things that can't be changed

Another waste of energy is continually fretting about things that are impossible to change. These could be called "The Givens" in a situation. For example, people sometimes fret about some minor imperfection in a partner or an inconvenience of the workplace. It is a "Given" with some jobs that there will be paper work and forms to fill in. These are a pain in the neck - but they go with the territory and fretting about having to do them won't change the situation. The other things that are part of the job (the reasons why you decided to work for this organisation) must not be overlooked. They may be rewards from the job itself, or they may simply be that you value the money and made a contract to perform certain tasks for a wage. These reasons for working can help to make up for the down side. Try to emphasise these and don't build up the uncomfortable "Givens" so that they overwhelm you.

Get rid of irrational ideas

Most people have some beliefs which they have never challenged. These are usually beliefs that have developed since childhood but which are really irrational;. Albert Ellis, an American psychologist, developed a list of common irrational ideas. These can become part of our self talk and we become upset when the world doesn't behave the way we think it should. The self talk then usually is, "It is really terrible and a catastrophe that ...." Some of the beliefs are:

- I must be loved or approved of by every significant person in my life

- I must be competent, adequate and achieving in all respects if I am to consider myself worthwhile
- It is terrible and catastrophic when things are not the way I would very much like them to be.

A little thought will clearly show that it is impossible to be approved of by everybody all the time. The truth is that it would be nice to be approved of by everybody at all times - but this is impossible. So it is a waste of energy to fret too much when feedback comes that says we have lost the approval of someone temporarily. That is not to say that we should not take steps to see if we should change our behaviour or attitude. Taking a constructive problem solving approach is sensible -worrying or fretting about the loss is not. Questioning personal beliefs about approval and fairness can often help maintain a realistic approach.

Other stress management strategies - art or a diary

Many fine paintings have been completed to express strong emotions. One famous painting "The Scream" vividly expresses terror. Whether talented or not, great satisfaction may be obtained from slapping paint on paper as a form of self expression. "Some people feel reluctant to discuss problems with others and find keeping a diary is a satisfactory way to reduce unpleasant feelings. Writing honestly about how you feel about a problem can sometimes help reduce the feelings. In a diary that only you will read it is quite OK to be angry or sad. Of course, you would need to ensure that such private thoughts would only be read by someone else if you wished them to.

To summarise:

The first step is to know and understand the stress response. It is important to know that it is normal, thought uncomfortable, and to realise that it can be dealt with.

The second step is to be self aware and limit any increase in stress levels by implementing a stress management regime.

The third step is doing

Maintain a healthy lifestyle,
have an active exercise program,
regularly practice relaxation,
use sensible "self talk" with a problem solving basis,
have strategies to reduce stress ready for times you need them.

Finally, do not use self medication through alcohol or extra caffeine to see you through stressful situations. This can lead to abuse and habits that are hard to break. If this has already happened with you, perhaps you should discuss this with your general practitioner.

These are the keys to defeating stress.

-ooOoo-

RTPCL582

BIENNIAL NOXIOUS PLANTS CONFERENCE 1995
WEED ALERT

Bob Trounce
Weeds Agronomist
NSW Agriculture
Orange

Experience and history has shown that early detection of a weed is paramount to effective and economical eradication; surely the aim of any weed control program.

A large percentage of weeds in Australia were intentionally introduced and therefore were not recognised as a weedy species for some time.

Lack of botanical knowledge in the 1800s also limited the recognition of potential weeds. Early records of introduced plants to Australia did not start until about 1838 when a writer recorded that in South Australia most introduced plants were identified as a member of the orchid family because no one was trained in botany. One of the earliest plant lists was William Macarthur's Catalogue of plants propagated for sale in 1943. An astonishing number of species being sold for propagation in the late 1840s are now familiar names on our Noxious Weeds List.

In a way we are slow to learn when you consider the almost disastrous introduction of Kochia in Western Australia in 1991.

PLANTS OF CONCERN

Declared Noxious Weeds

1. Siam Weed - *Chromolaena odorata* - W1

Considered to be one of the world's worst weeds, in July 1994 was discovered for the first time in Australia, growing in clumps along the Tully River in North Queensland. It has the potential to infest coastal areas of northern Western Australia, Northern Territory, Queensland and New South Wales.

Description
Siam weed has a perennial growth habit like lantana, but with soft green triangular leaves. Stems are soft, round and bear masses of lilac or white flowers in winter. Seeds are small (5mm) with a pappus which allows them to disperse on the wind. Seeds can also stick to people, animals and machinery.

Habitat
Invades pastures, plantation crops and forestry areas where some sunlight penetrates. Once established the plant will scramble over other vegetation in competition for light and space to heights of around 20 metres.

Weedy attributes

Competitive. Produces skin allergies and has an allelopathic effect on other plants germinating under its canopy. Stems die back in the dry season and become a fire hazard, but the onset of suitable conditions promotes regrowth from the crown.

It is a recognised weed around the world, especially in Africa, tropical America, India and south east Asia. It is still spreading through the Philippines, south west China and South Africa.

Eradication program
A consultative committee convened by AQIS in August 1994 concluded that a National campaign should be prepared. The campaign is led by the Queensland Department of Lands, and all known infestations have been treated at a cost of approximately $250,000. Costs are being shared by the Commonwealth and states which are at risk of *Chromolaena* establishment.

2. Kochia / Burning bush - *Kochia scoparia*

A summer growing annual introduced into Western Australia to revegetate salt-affected areas. The plant was quickly recognised as an invasive species in this environment by the rapid natural spread and was declared noxious in 1992. Kochia is also a major weed of the U.S.A. and Canadian wheat belt.

Description
Kochia is native to eastern Europe and western Asia.

It is an erect annual, growing to 1.5m tall. It usually has a main stem that bears many braches, giving it a tumbleweed shape. Young shoots are often hairy and leaves are flat and elongated to 50mm long and 8mm wide. The leaves also have three longitudinal veins on the underside. The small, insignificant flowers are borne along the upper portions of the shoots.

As the plant ages, its colour changes to pale yellow, pink and dull brown.

Dead plants break off at ground level and are blown by the wind, sometimes over long distances, scattering seeds along their track.

The fruit is small (2mm across), star shaped and contains a single seed.

Habitat
The plant will establish on many soils including saline and scalded areas and competes readily with pastures and wheat crops. Dense infestations can build up quickly in ditches and along fence lines where the bushes have been halted along their tracks.

Weedy attributes
As well as the prolific seeding and quick means of seed dispersal by blowing bushes, a major cause of concern is the allellopathic and auto toxic effect of the weed. Kochia plants have been found to cause reductions in germination and growth of many crop species as well as limiting the number of kochia seedlings which can establish in a localised area.

Shoots have been found toxic to a variety of animals, causing diseases in sheep and cattle.

Eradication program
A consultative committee was formed as soon as kochia was recognised as a serious pest and a nationally funded eradication program was mounted. All known outbreaks

in Western Australia have been treated and the areas will be monitored to ensure no regeneration occurs. All states have listed the plant as a prohibited species.

3. Lippia - *Phyla nodiflora*

The plant was introduced into Australia as an ornamental and is often seen in gardens or used as lawn species in almost every town.

Description
A mat forming perennial, rooting from nodes or leaf joints. Stems are square, leaves opposite, rounded and toothed at the tip with a wedge shaped base. Leaves are up to 5cm long and 1cm wide. Flowers are small, white to pink, in heads on stalks up to 10cm long and are both self and cross pollinating.

Habitat
Lippia has become well established along many of the inland rivers of NSW as well as along the north coast. It prefers heavy grey soils which predominate on floodplains, although it will establish on sandy and loamy soils. Its distribution is from Queensland to Victoria.

Weedy attributes
Reproduction by seed and vegetatively allows the plant many opportunities to spread. The plant is also frost and drought resistant and can withstand inundation by up to 30cm of water for up to 3 months.

The plant does not pose a threat to cultivated areas, however is a threat to watercourse areas and grazed natural pastures.

Future action
The most likely action is to prevent future sale of the plant and prevent spread wherever possible. Lippia was recently declared as a W4c weed in three councils.

4. Horsetail - *Equisetum* spp.

There are a number of species of Equisetum growing in NSW, mostly in confined areas or pots.

> *Equisetum arvense* - recorded in 1927 growing at Barrington Tops and recorded by the National Herbarium, Sydney. In 1989 extensive infestations were found at Belrose and Bayview Heights north of Sydney
>
> *Equisetum variegatum* - Identified in 1993 as a species being sold on the north coast for use as a herbal tea. This species is less branched than *E. arvense* and has a black band on the apex of sheaths.
>
> *Equisetum hyemale* - In 1995 this species was found in a public park at Taree spreading from a garden to adjacent lawn areas.

As a result of this, all Equisetum species have now been declared noxious in NSW.

Description
Herbs with annual stems from perennial rhizomes which grow up to several metres long and about one metre deep. Stems are grooved and some species abundantly

branched. Fertile stems are produced early in the season (spring/summer), the cone shaped head shedding spores before they die. The root system is a wiry rhizome which quickly spreads through the soil giving rise to fronds along its length.

Habitat and Distribution
Grows in cold to warm temperate regions with a minimum of 100mm of annual rainfall. It enjoys rocky seepage areas which are shady and damp.

Equisetum is a native of South Africa, Europe, Asia, North America and is common throughout the Northern Hemisphere. Large areas are reported in New Zealand where the plant grows in pastures.

Equisetum arvense is naturalised in NSW at two known sites.

The genus is a declared noxious weed in NSW, South Australia, Queensland and Tasmania.

Weedy attributes
Horsetail can reproduce from spores or pieces of rhizone. Control is difficult because of the depth of the root system and the fact that it enjoys rocky areas. The plant does not effectively translocate herbicides to the roots from the fronds, thus soil active herbicides are necessary to obtain control.

Future action
An eradication program has been set in place for the Belrose and Bayview Heights infestations and licences to treat the creek systems have been approved by the Environment Protection Authority.

A permit has also been approved for action to be taken by Taree City Council to eradicate the infestation at Taree.

Undeclared species

5. Wait-a-while - *Caesalpinia decapetala*

The first report of *Caesalpinia* in New South Wales was in 1911 when it was found near Ryde Station (Sydney) and a further infestation was recorded at Mt Kembla in 1953.

Dr Leon Smith and Mr Peter Gorham inspected the infestation at Mt Kembla Village near Wollongong in 1982, reporting that the plant was extremely competitive with existing vegetation.

Further reports have been confirmed on the north coast from the Tweed Shire to Port Macquarie and at various sites in Queensland.

Description
The plant is a thorny rampant bramble, a native of south east Asia. Older trunks can be up to 20cm in diameter, reaching 20 metres high when supported by other trees. Leaves have 6 to 10 pinnate pairs. The plants winter flowers are bright yellow and pea like. The fruit is a pod containing 3-8 seeds olive to grey in colour.

Weedy attributes
The plant can scramble over other vegetation forming impenetrable thickets. Backward turned thorns make control work hazardous and slow. A favoured habitat along creek lines allows seeds and pods to drop into the water where they may be transported some distance to a new site.

Control
Control trials are being carried out at the Wollongong site testing a number of foliar applied herbicides and work is progressing at Port Macquarie to clear the historic Innes House Ruins. The method used here has been cutting and painting stumps at ground level.

6. Rice grass - *Spartina townsendii*

Rice grass was introduced into Australia deliberately on a number of occasions between 1920 and 1977 from England and the USA for the purpose of shoreline protection and land reclamation. Points of introduction were in Tasmania, South Australia, Victoria and Western Australia. An infestation also has been reported at Jervis Bay on the New South Wales north coast.

Description
Spartina is an erect grass which colonises the intertidal areas of lagoons and estuaries. The grass has leaves which are attached to stems at right angles and are brittle. The plants grow to about 1.5m in height and flowers are usually 3 spikes at the end of stems.

Botany
Early introductions of rice grass were of two main species, *S. anglica* and *S. townsendii*, the latter which developed as a hybrid between the native English *S maritima* and American *S. alternafolia* which had also been introduced into England 100 years previously. Not all forms are fertile and *S. anglica* is generally accepted as the fertile form.

Habitat
Rice grass will colonise areas subject to tidal inundation on a wide range of substrates from deep silt to sand, only requiring intermittent tidal inundation to survive.

Weedy attributes
The plant can propagate from pieces of root washed by tide to a new site or fertile seed when produced. It has the capacity to aggrade sediment at the rate of 3-5cms per year, eventually producing a dramatic change in the ecology of the tidal area.

Changes to these areas have a dramatic effect on feeding areas of migratory wading birds.

Control research
Trials are underway in Tasmania and Victoria to find an acceptable and economical control. Various herbicides have been tested as well as physical control. Small areas can be dug up and destroyed while black plastic held down by chicken wire and tent pegs has shown promise and is undergoing further evaluation.

The prospects of controlling "meadows" covering many hectares is still questionable at this stage.

7. Chinese Dragon Tree - *Paulownia fortunii*

Also called Pouton Saphire Dragon, the genus has a number of species including *P. Tomentoso* and *P. Cecum*. Several may be promoted in Australia. This fast growing tree is being actively promoted for Agro-forestry use through nurseries and especially at field days and agricultural shows and has been grown as ornamental tree on the tablelands for may years.

Description

The Paulownia is of Chinese origin, selected by Firestick Ltd. The tree has been developed for hardwood production to be used as building timber and to be pulped and chipped.

The tree is deciduous and can be grown from seed or cuttings - under good conditions reaching a height of 6 metres in six months, growing to 13 metres with a metre thick trunk in five years.

Habitat

The species is suited to summer rainfall areas which are well drained as the plant does not appear to tolerate wet feet. Relatively fertile soils would be favoured for active growth.

Little is recorded about the plants competitive ability but its speed of growth would give it a shading advantage.

Weedy attributes

The production of fertile seed and ability to grow readily from pieces of branch or cuttings gives the plant weed potential. One grower has reported extensive natural spread over a number of hectares from one small planting.

Future action

At this stage the plant is not listed as a noxious weed and data is being collected. Reports of invasiveness will be verified and documented for possible future reference of the Noxious Weeds Advisory Committee.

8. Willow - *Salix* spp.

There are at least twelve species of willow as well as many hybrids, now naturalised along most rivers and streams in south eastern Australia. Willows have beneficial features in some situations, providing soil stability, shade and even fodder for livestock. The genus is currently being surveyed in NSW, ACT and Victoria.

Description

Salix is a large northern hemisphere genus of ground covers, shrubs and trees. Tree willows are summer growing, usually deciduous, growing to 20 metres high. Plants are dioecious and flowering occurs in spring. Although they have separate male and female forms, most early introductions were female only and did not produce viable seed.

Weedy attributes

Willows continue to be introduced from overseas without appreciation of their weed potential. Seeding populations of willows have been identified recently indicating that both sexes are growing frequently close enough for pollination to occur. In Australia

ten species are present as females, and all but one of these (*S. Babylonica*) have been found to produce viable seed. One hybrid in particular, *S. matsudana x S alba* is self fertile.

Future action
At its 1994 meeting the Australian Weeds Committee resolved to seek the Australia Quarantine and Inspection Services support to prevent further introductions of *S. matsudana* x *S. alba* hybrid willows into Australia. Also to seek support of the nursery industry and Landcare/Catchment groups to prevent further planting of this hybrid and remove existing plantings - replacing with other Australian native tree species. Extreme care needs to be exercised when deciding whether to clear streams and rivers of willow to avoid deterioration and instability of the bank.

Willows are not a declared noxious weed.

9. Cabomba, Fanwort - *Cabomba caroliniana*

Cabomba has been recorded in several locations in NSW such as at East Lakes Golf Course Sydney, Murwillumbah and Byron Bay. The greatest threat posed by the weed however is from trading by aquarium supplies wholesalers who are selling the weed to aquarium owners and fish breeders.

Description
A submerged aquatic perennial, native to North America that grows from temperate areas to the tropics. The plants are usually rooted at the bottom of lakes, dams or slow moving streams. Plants bear a white flower in November to March which is held above the water.

Weedy attributes
Cabomba causes considerable obstruction to streams and drains in the southern United States. It has become naturalised in several areas of Queensland and the north coast of NSW.

Free floating segments can survive and commence a new infestation.

As the plant is almost totally submerged, treatment with effective herbicides is difficult.

Future action
It is important to prevent future trading in the species for aquarium use and prevent future spread from existing infestations.

Cabomba is not a declared noxious weed.

-ooOoo-

RTPCD589

WEED AWARENESS WEEK 1996

Bob Trounce
Weeds Agronomist
NSW Agriculture
Orange

Previous Weeds Awareness Weeks were held in 1986 and 1990, being coordinated as a cooperative venture between NSW Agriculture, Noxious Weeds Advisory Committee, the NSW Noxious Plants Officers Association, Local Government Councils and the Shires Association.

The purpose of Weeds Awareness Week is to raise the profile of noxious weeds in New South Wales and the organisations responsible for their control.

In 1990 a large weeds exhibition was staged on the lawns of the Royal Botanic Gardens, Sydney. Dignitaries were invited to an official opening by the Minister for Agriculture and the public had the opportunity to visit the display over three days.

In addition to this major display, field days, displays and seminars were encouraged to be organised by other organisations. A special school kit was posted to schools and invited school groups to visit displays, enter competitions and become involved in weed control in their local area.

To make the promotion successful, it is necessary to form an active committee of 9-10 people. In past years this has included the five Noxious Plants Advisory Officers and four weeds officers with LCAs. This committee then coordinates the following:

Sponsor/s	-	Prizes for competitions
	-	Funding for displays
Types of competitions	-	Colouring (primary) (overwhelming response in 1990)
	-	Weed Competition - Completing a question sheet on weed facts - most of which is answered at the major display.
	-	Video competition (mainly for high schools)
Major display	-	Venue
	-	Timing
	-	Opening/launching ceremony
Literature and publicity	-	Mailing lists
	-	press outlets
	-	media interviews
Special announcements	-	This is an ideal time to announce new weed programs, publicise successes, make bio agent releases etc.

Towards 1996

There is already a lot of interest by community groups and councils to be involved with another Weeds Awareness Week. Such a week is overdue and if all authorities and

interested parties work together we can have a major impact to raise the profile of weeds in the community.

A letter has been written to the Premier's Department from the Director-General of Agriculture advising that a major promotion for weeds awareness will be staged during the week of 16-22 October 1996. I urge all delegates to make a note of these dates and help promote noxious weed control in New South Wales.

-ooOoo-

OBJECTIVES OF THE WEED SOCIETY OF NSW

1. To ensure that those interested in weeds and their control are able to meet, to exchange their knowledge and experiences, and to learn of new developments/research.

This will be achieved by
(a) organising meetings/workshops/seminars, held at both urban and rural locations.
(b) publishing a newsletter containing the latest information on weeds in NSW and the rest of Australia.
(c) forming regional groups to ensure interaction at a local level.
(d) providing funds for members to travel to increase their knowledge.
(e) circulating a list of members details within the society.
(f) organising Australian Weed Conferences on behalf of CAWSS.

2. To increase general public and the policy makers' awareness of the effects of weeds and their control.

This will be achieved by
(a) mounting and sponsoring displays, as a society or in collaboration with others, at public events.
(b) organising and participating in talks in areas/topics in which weeds or weed control are an issue (so that non-members can benefit from the knowledge of members).
(c) promoting/encouraging the development and publication of educational material.
(d) encouraging members to participate in teaching at secondary and tertiary education level.

3. To represent the interests of members at State and national levels through full involvement in CAWSS and other organisations.

This will be achieved by
(a) informing other organisations and individuals of the existence, activities and aims of the society.
(b) providing CAWSS delegates.
(c) responding to requests from CAWSS for advice and assistance.
(d) when considered relevant to the society, providing input into formulation of policy at a state level.

LTSMD085

The Weed Society of New South Wales was formed in 1966, and has a current membership of about 250. The Society holds or sponsors frequent workshops and field days on aspects of weed biology, ecology and control, as well as environmental issues. Conference fee discounts often apply to Society members. Members receive newsletters four times a year detailing activities and advances in weeds, both within NSW and nationally.

The membership fee is $20. There is no joining fee. For further information please contact the Secretary, PO Box 438, Wahroonga NSW 2076.

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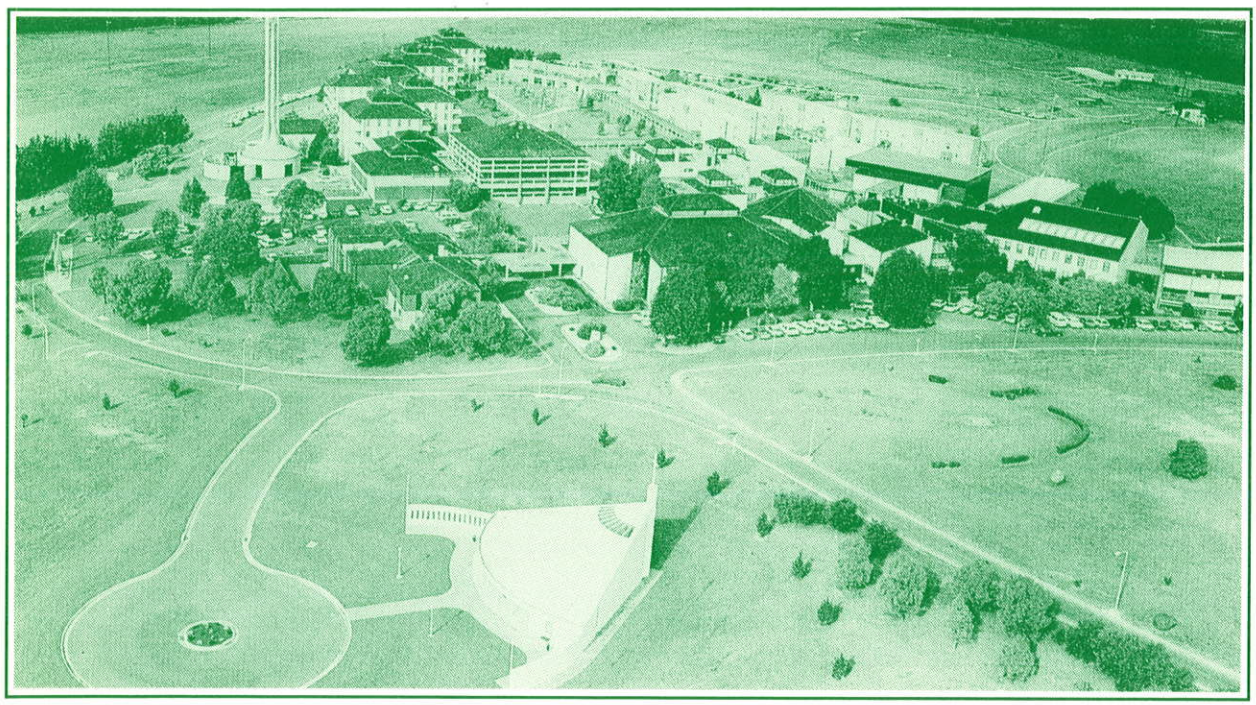
8th BIENNIAL NOXIOUS WEEDS CONFERENCE

"Better Planning for Better Weed Management"



NSW Police Academy Goulburn

19-21 September 1995

Volume 2

Eighth Biennial Noxious Weeds Conference

Police Academy Goulburn, N.S.W. September 19-21, 1995

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Proceedings of the 8th Biennial Noxious Weeds Conference

Volume 2

Police Academy
Goulburn, N.S.W.
September 19-22, 1993

Peter Gorham
Conference Convener
NSW Agriculture
Cowra

Many thanks to
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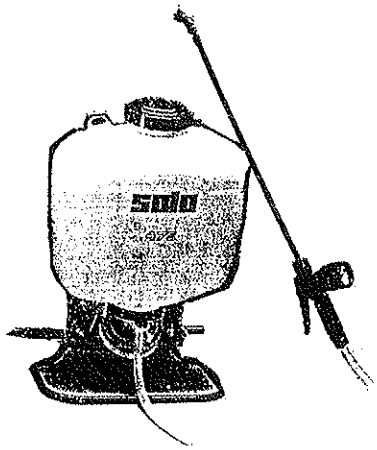

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1

CONTENTS

Volume 1

CONTENTS - VOLUME 1

CONTENTS - VOLUME 2

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PROGRAM

8th Biennial Noxious Weeds Conference

Tuesday, 19th September
Wednesday, 20th September
Thursday, 21st September

NSW Police Academy
GOULBURN

1995

8th BIENNIAL NOXIOUS WEEDS CONFERENCE

Program

DAY 1 - TUESDAY, 19th SEPTEMBER 1995

CHAIRMAN - VAL STUBBS, MID-WESTERN COUNTY COUNCIL

8.30 Housekeeping ..... *Peter Gorham*
8.40 Welcome to the Academy ..... *Reg Mahoney, Chief Superintendant*
8.50 Welcome to Goulburn City ..... *Mayor of Goulburn*
9.00 Opening Address ..... *John Wearne, President Shires Association of NSW*
9.15 Strategic Approach to Noxious Weed Control ..... *Doug Hocking, NSW Agriculture*
9.35 Keynote Address: "Weed Management Towards 2000" .....
..... *Dr Bruce Wilson, Qld Dept of Lands*

10.00 **Morning tea**

CHAIRMAN - IAN KELLY, CASTLEREAGH-MACQUARIE COUNTY COUNCIL

10.30 National Weeds Strategy: From Words to Action ..... *Ian Smith, Agriculture Vic*
11.00 Noxious Weeds Strategy for NSW ..... *Bob Paton, Consultant*
11.20 A Strategic Approach to Planned Management -
Serrated Tussock Action Plan ..... *Bob Sproule, NSW Agriculture*
11.45 Bitou Bush Control in the Shoalhaven with Community Involvement .....
..... *Ian Borrowdale, Shoalhaven City Council*
12.00 Managing Vegetation in an Urban Environment Based on Catchments .....
..... *Dr Jocelyn Powell, Hawkesbury Nepean Catchment Management Trust*

12.30 **Lunch**

CHAIRMAN - BOB LEECH, CROOKWELL SHIRE COUNCIL

1.30 Setting Priorities in Industrial Weed Management ..... *Jim Longworth, State Rail*
1.50 An Enhanced Weed Management Program for NSW National Parks .....
..... *Dr Andrew Leys, National Parks & WildlifeService*
2.10 Cycle Planning for Effective Woody Weed Control ..... *David Theriault, DowElanco Aust*
2.30 Promoting Yourself Through Planning ..... *Ken Fishpool, NSW Agriculture*

3.00 **Afternoon Tea**

DAY 1 - TUESDAY, 19th SEPTEMBER 1995 continued

CHAIRMAN - RON FRANCIS, BLUE MOUNTAINS CITY COUNCIL

3.30 Mapping Weeds Accurately Using GPS ..... *Peter Terrett, Global Star*
4.00 Long Term Planning Success in Containing Mimosa Pigra .....
..... *Ian Miller, Northern Territory Department of Primary Industry & Fisheries*
4.20 Computerised Inspection & Mapping Program ..... *Scott Clark, Rapid Map Australia*

EVENING SESSION

7.00 Elected Members' Meeting .....
Noxious Weeds Officers' Association Meeting .....

DAY 2 - WEDNESDAY, 20th SEPTEMBER 1995

CHAIRMAN - KIM BELLAIRS, FAR NORTH COAST COUNTY COUNCIL

8.30 Biological Control of Weeds in NSW ..... *Paul Sullivan, NSW Agriculture*
8.40 Mapping Weeds for Biological Control Programs ..... *Alan Maguire, NSW Agriculture*
8.50 Role of Council Weeds Officers in Biological Control Programs .....
..... *Paul Sullivan, NSW Agriculture*
9.00 Licenses for Herbicide Use in or Near Water ..... *Dr Jane Mallen-Cooper, EPA*
9.20 Saving Wetlands from Weed Invasion ..... *Geoff Sainty, Sainty & Associates*
9.40 Groundsel Bush Management Plan ..... *Jeff Thomas, National Parks & Wildlife Service*

10.00 Morning tea

CHAIRMAN - ROB DONOHOE, GRAFTON CITY COUNCIL

10.30 Streambank Weeds ..... *Geoff Sainty, Sainty & Associates*
10.45 Alligator WeedMIA Campaign - Has it Been a Success? .... *Hugh Milvain, NSW Agriculture*
11.05 Parthenium Weed Alert ..... *Peter Gray, NSW Agriculture*

11.40 Lunch

12.30 FIELD TOUR - CSIRO CANBERRA

Tour of facilities - Update on current and planned weed biological control programs - Scientists and Technicians from the Division of Entomology.

Division of Plant Industry biological control programs, Dr Richard Groves. Also from the Division of Plant Industry, Phil Larkin and Danny Llewellyn will talk about genetic engineering in plants.

6.30 EVENING MEAL - HELLENIC CLUB, WODEN

DAY 3 - THURSDAY, 21st SEPTEMBER 1995

CHAIRMAN - PETER GRAY, NSW AGRICULTURE

8.30 Legal section - the Noxious Weeds Act 1993 - Is it working? - Changes? Problems? Penalty Notices? Answers to Questions Put by Leas and Other Groups in Response to Survey - Declaration of W4 Weeds in Urban Areas - Property Inspection Procedure *Sally Pearmain, NSW Agriculture* ..... *Lesley Skinner, NSW Agriculture*

10.00 **Morning tea**

CHAIRMAN - IAN TYE, MACLEAN SHIRE COUNCIL

10.30 Herbicide Resistance - Which Herbicide Group? ..... *Jim Dellow, NSW Agriculture*
10.50 Managing Silverleaf Nightshade ..... *Barney Milne, NSW Agriculture*
11.10 Dupont Product Update ..... *John Abbott, DuPont Aust*
11.25 Proper Management of Empty Farm Chemical Containers ..... *Doug McGuffog, Avcare*
11.50 Analysying Weedicide & Pesticide Residues for Compliance to Occupational Guidelines ..... *Robert Geyer, Workcover Authority*
12.10 The Advantages of Using Retractable Reels ..... *Grant Mitchell, Quick Spray*

12.30 **Lunch**

CHAIRMAN - KEN HAYES, COFFS HARBOUR CITY COUNCIL

1.30 Adjuvants - Future Trends ..... *Alex McLelland, AB McLennan Management Services*
1.50 Prickly Pear - A New Noxious Weed ..... *Les Tanner, NSW Agriculture*
2.05 Water hyacinth in the Hawksbury-Nepean River System ..... *Geoff Keech, Macspred*
2.25 Product Update ..... *Keith Fallow, Monsanto Aust*
2.40 Dry Product Technology & Envirodrums ..... *Nufarm Ltd*

3.00 **Afternoon tea**

CHAIRMAN - GRAHAM MATTHEWS, BELLINGEN SHIRE COUNCIL

3.30 What is Stress? ..... *Jan Westerink, Aust. Graduate School of Police Management*
4.00 Potential Invaders- Weed Alert .....
Weeds Awareness Week 1996 ..... *Bob Trounce, NSW Agriculture*
4.30 Closing Address ..... *John Fisher, NSW Agriculture*

7.00 CONFERENCE DINNER

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A word from the Conference Convenor

Organising a conference can stir up a few anxieties! How many will come? Will the topics be of interest? Will the venue be suitable?

Well, as Hugh Mulvain often says, "NOT TO WORRY" and he was right. This was our biggest attendance yet - over 300 delegates - and from all reports, a very successful conference with the venue being given the thumbs up and I heard on the grape vine it was a very successful week for the bar sales. I didn't receive any discounts though or any complementary exemptions from future infringement notices. "NOT TO WORRY".

As mentioned above the conference was a great success and this was due to a team effort. Firstly my thanks go the members of the organising committee for their input into the structuring of the conference and their untiring assistance during the conference.

My personal thanks to all the speakers for giving their time to present their papers which certainly conveyed excellent technical information on a number of weed control practices, information that is not always available from other sources. Their presentations certainly highlighted the conference theme, "Better Planning for Better Weed Management".

A special thanks to all our sponsors. Their support and sponsorship of the many competitions over the years has played a significant role in ensuring the conferences are successful. A special thanks must go to DowElanco Australia, Du-Pont Australia and Monsanto Australia who have been loyal sponsors since the first conference in 1981.

Many thanks also to the chairpersons who ensured all the sessions ran to time. A special thanks also to Les Tanner, Proceedings Editor for the countless hours spent at the keyboard.

Another person who deserves a special mention is our good friend Sharon Corey, from the CSIRO at Canberra. Sharon helped in organising our mid-week trip to Canberra - the CSIRO presentations, the brief tour of Canberra and our evening meal. Thanks, Sharon!

Congratulations to Kim Bellairs for her appointment to President of the Weeds Officers Association. Also to the winners of the Competitions and Awards.

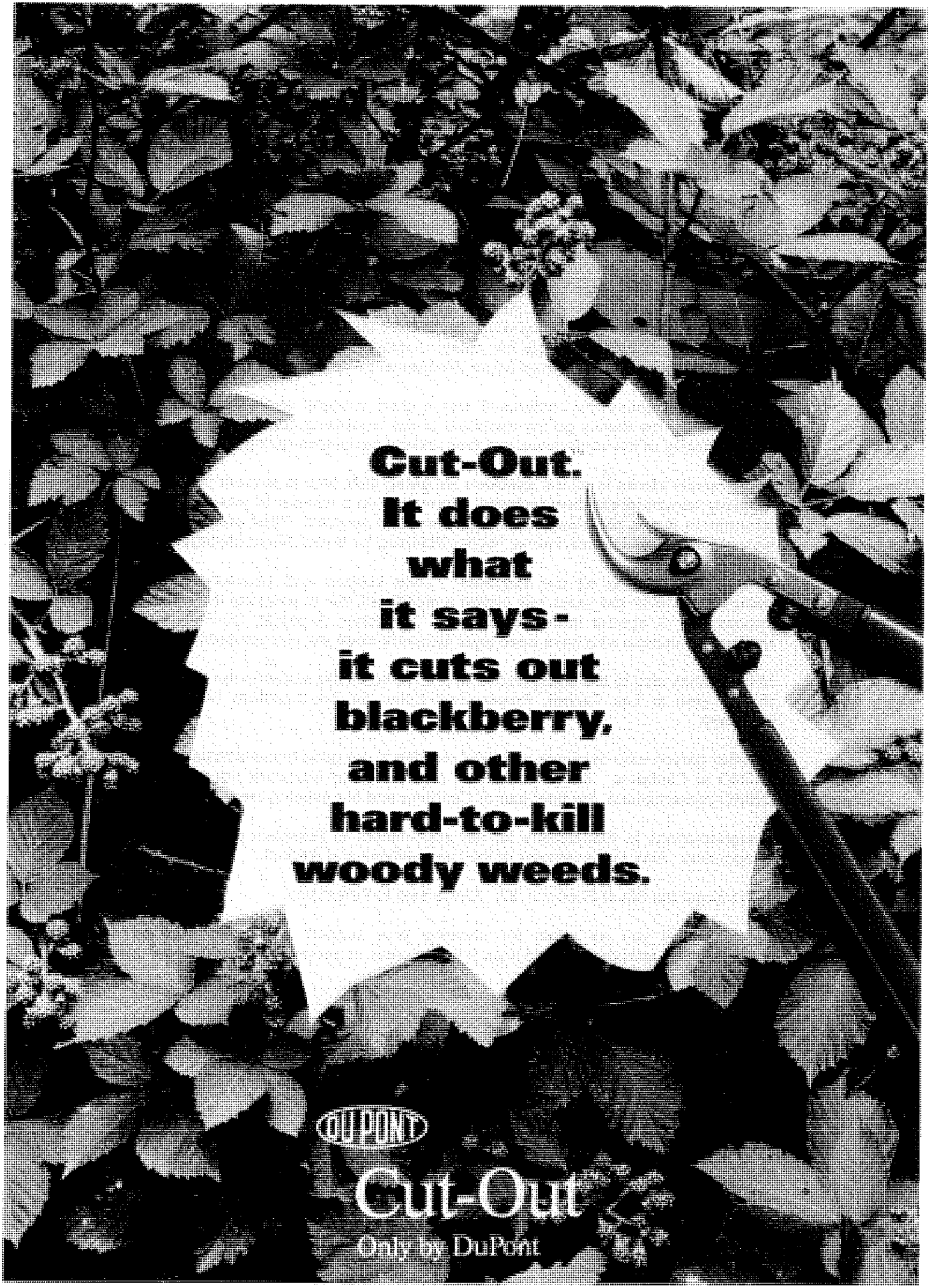
Don't forget the 9th at Dubbo in '97. All the best to Peter Gray.

Lastly, thank you all again for showing your support for the conference by the overwhelming attendance and I hope it was a week of gaining and sharing information and catching up with old mates.

Many thanks

Peter Gorham

Peter Gorham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OFFICIAL OPENING
EIGHTH BIENNIAL NOXIOUS WEEDS CONFERENCE
GOULBURN, 19 SEPTEMBER, 1995

Councillor John Wearne
President
Shires Association

Delegates, ladies and gentlemen

I would like to begin by saying how pleased I am to have the opportunity to open this most important conference. I would also suggest that the growing importance of noxious weed control within NSW and, indeed, nationally is reflected in the impressive number of you who are attending this conference as delegates.

Ladies and gentlemen, in any language, weed control is big business. I am going to have to leave it to history to judge whether our endeavours in the future will be big enough to hold the line against what are clearly ever-encroaching problems.

It has been estimated that the cost of noxious weeds to agriculture is about $3 billion per annum. This represents an enormous loss in productivity.

Our response in NSW is to apply something like $15 annually towards weed control and eradication. The funding sources - and I will stand correction on these figures - is $4.5 million from the Department of Agriculture's internal budget and something approaching $5 million from Local Control Authorities which is matched by an equivalent State Government grant.

Consequently, a strategic approach towards identification, classification, prioritisation and control measures themselves is absolutely vital, and it is encouraging to see a number of sessions listed on the conference program dealing with strategies.

When you are attacking a $3 billion problem with a $15 million solution - which is akin to belting Mike Tyson with a feather - there is no room for anything but the maximum levels of efficiency and cost effectiveness.

When we mention Local Control Authorities, then this is where Local Government comes in and the key message I wish to leave you with today is that the Local Government and Shires Associations are totally committed to the suppression and eradication of noxious weeds and to pressing the State Government for more funds with which to do so.

And, of course, noxious weeds are not only a rural problem. There are particular concerns in our urban communities as well which are not being fully addressed.

These are not only related to land management. There are problems with the spread of noxious weeds in our waterways, such as the Hawkesbury-Nepean System.

I was interested to see that a session has been set for tomorrow morning on streambank weeds.

This is particularly interesting in view of the work currently being undertaken by Weeds Control Officer and Advisory Committee member, Mike Boulton, who is working on the preparation of a GIS inventory on the status of aquatic weed infestations in this state.

The involvement of the Shires Association in noxious weeds issues goes back many years. As many of you would know, the Association is organised on a Divisional basis with the Executive Council elected by the Divisions. Until about fifteen years ago, there was a Division specifically for all county councils including those set up for noxious weeds eradication.

The Executive decided in 1980 that apart from the noxious weeds authorities, county councils should transfer into the Division closest to their headquarters. The idea was for noxious weeds to be given higher priority.

The Divisional representative of the noxious weeds counties was also a member of the Noxious Weeds Advisory Committee.

This arrangement worked reasonably well, however, is recent times there was growing concern for our general purpose councils that they did not have enough opportunity to be involved in policy making or have sufficient contact with the Noxious Weeds Division representative because of the special Divisional arrangement.

The wheel has now come full circle and the June, 1995 Shires Conference resolved that the Division should be abolished and all noxious weeds matters should now be dealt with by the Executive. The noxious weeds county council's are now serviced with our general purpose members.

The view was that this would give the issues much higher priority. It would also allow general purpose councils direct access to raise issues and be more involved in finding out what was going on.

The Executive last month had a long discussion about the best way to now deal with the issues. One of the keys will be closer liaison with the Noxious Weeds Advisory Committee.

This body has three Local Government representatives: Cr Len Woods and Cr Malcolm Olive (Shires Association) and Cr Les Shore (Local Government Association). Together these members promote a Local Government view point through the Committee to the State Government.

I think it is essential that the Associations improve their links with these representatives, and the Executive has had discussions with Cr Len Woods about how this might be done. We have also talked to the Chair of the Committee, Doug Hocking.

I hope this explains the Associations' commitment to maintain the priority we believe needs to be given to this issue.

We have also spoken to Doug Hocking about holding a series of a regional seminars next year about noxious weeds problems and solutions.

Our member councils have told us very clearly they want us to spend more time in the country listening to their problems. Interactive seminars are a good way to do this. The intention is to visit four or five regional centres which have good access points to rural communities. Our speakers would present the same material at each session and the intention would be that the seminars are action oriented rather than just talk fests.

I am keen that the Association use the expertise of our member councils more in problem identification and solution finding. The Shires Executive, while it represents all rural councils, does not have all the answers. But the collective skills of the 1,850 or so councillors spread right across NSW can bring a powerful knowledge basis to promoting change. That is a major initiative I would like to see during my term as President.

I think we need to have creative solutions to a big problem. There are simply not enough funds available from government to do all the work necessary. We need to build better links with bodies such as the Total Catchment Management Committee and Trusts and Landcare, which do have access to reasonable funds, so they can factor noxious weeds issues into their policies and priorities.

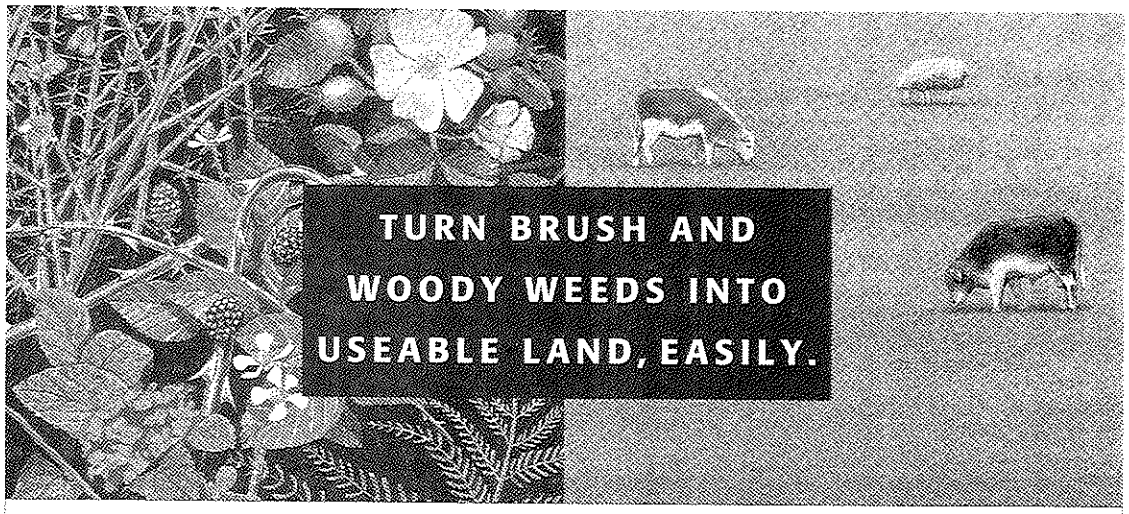
I was delighted to be given the opportunity to open this most important conference and to reassure you about the Association's commitment to maintaining our policy profile.

This conference represents an excellent opportunity for appropriate agencies and practitioners to get together and discuss the latest developments in this key area.

Both Associations will continue to give high priority to encourage the government to provide improved funding and better coordination of the various bodies responsible for land car in all its forms.

Ladies and gentlemen, it is a great pleasure for me to declare this 1995 Noxious Weeds Biennial Conference officially open.

--ooOoo--



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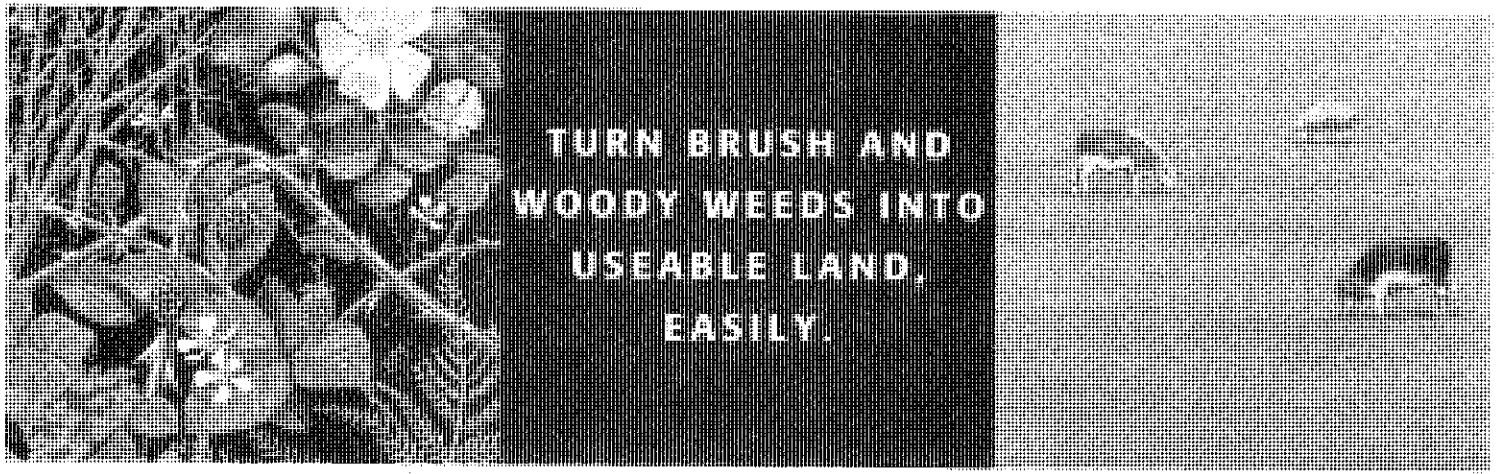

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WEED MANAGEMENT TOWARDS 2000

Dr Bruce J Wilson
A/Director, Research
Land Protection Branch
Queensland Department of Lands

ABSTRACT

Future weed management should be based on the following key principles: preventative weed management, planning, sustainable land use, conservation of biological diversity, local ownership of issues, readily available information, objectively-based decision making, community awareness, whole systems approach, maximising resources and training.

Weed management plans are classified according to scale (from national to property level) and scope (single species or comprehensive). Plans at each level of scale must be consistent with those higher in the hierarchy and single species plans must be consistent with comprehensive plans. Weed management plans must also link into the hierarchy of natural resource management and organisational plans. Queensland is implementing Local Government pest management and property-based species plans.

In addition to planning, the principles are being addressed with other initiatives in Queensland - management of potential weeds, pest status assessments (reviews to identify control objectives, policy and information gaps), urban community awareness of weeds, Ministerially approved policy development, strategic weed control and an information system (Pestinfo).

INTRODUCTION:

Australia is entering a challenging and potentially very rewarding period for weed management. There are many changes occurring which are to the advantage of weed management - the recognition of the importance of weeds at "grass roots" level in the landcare movement, the recognition of the conservation impact of weeds and the development of the National Weeds Strategy, to name just three. Whilst there are changes which challenge current weed management methods, such as the issue of chemical residues, these are clearly secondary to the positive changes.

This review addresses the principles for future weed management, the relationships of weed management plans and examples of initiatives in Queensland.

PRINCIPLES FOR FUTURE WEED MANAGEMENT

Preventative weed management

Preventing the introduction of weeds and early control of new infestations are by far the most cost effective methods of weed control. This principle can be applied at all levels of scale, from the paddock to Australia-wide. It involves the concept of potential weeds - species that could establish and have an adverse impact but are not yet present; they may not be a weed anywhere else.

Preventing the introduction to Australia of new plant species with weed potential, and ensuring early detection and rapid action against new weed problems is being addressed through the National Weeds Strategy. For weeds that are already established in Australia, there is still much that can be achieved from preventative management at the State, catchment, regional, property and paddock level. Implementing preventative weed management requires a shift of focus and resources in extension, policy, operational priorities and research.

Key requirements are:

1 landholder, industry and general community awareness of potential weeds and the means of spread.

2 ability of landholders, weed officers and other key people to identify potential weeds or obtain identification of any new or "strange" plants.

3 reporting procedures involving all herbaria.

4 contingency plans for action against new weed infestations.

5 effective technically-based procedures for restricting spread, appropriate to the scale.

6 consultation, co-operation and awareness involving nurseries, aquarium supply outlets and seed merchants.

7 legislative support, including legislation which is consistent between States.

A major component of preventative weed management is the concept of **strategic weed control,** defined as control of infestations which are strategically important in the management of the species. Weed infestations may be minor, having a negligible impact in their current location, but be a source for spread throughout the property, region, catchment or state. Control is clearly required to prevent spread, and assistance to the landholder(s) is strongly justified because of the wider community benefit.

Planning

Planning is a function for handling the future. It involves deciding on objectives or goals, and then deciding the "how", "what" and "who". The process includes involvement of all stakeholders, a scan of external and internal influences (including legislative obligations), an analysis of resources available, and establishment of implementation and monitoring mechanisms. Weed management plans range from the national strategic level to the farm operational level.

Planning provides the following benefits:

1 all participants achieve an increased understanding of the subject and increased ownership and commitment to the plan.

2 legislative and policy responsibilities are addressed.

3 a means of identifying issues and establishing priorities is provided; better resource allocation should follow.

4 allocation of responsibilities between and within organisations is clearer.

5 essential links with higher order weed management plans and organisational plans (e.g. corporate plan) are addressed.

6 increased stakeholder acceptance of obligations.

7 the plan and an assessment of its implementation provides a basis for accountability.

Sustainable land use

Sustainable use of renewable resources is essential for our long term survival. Sustainable land use is embodied in national and international agreements. It is supported by widespread concern for the environment and will clearly continue to be a strong priority for communities and governments (Taylor 1995).

Exotic weeds are a major factor in sustainable land use. Weeds are often a symptom of underlying land management problems, such as overgrazing and lack of fire. Economic pressures are also facilitating inappropriate land management regimes and a resultant increase in weed proliferation (Csurhes 1992). There is a clear responsibility to address current land management regimes which contribute to weed proliferation, and to develop weed management methods which are sustainable.

Conservation of biological diversity

Australia's long isolation from other continents has resulted in a flora and fauna that is very high in species unique to Australia. For example, 85% of vascular plant species and 82% of mammal species are endemic (Anon 1994). Thus the conservation of our biological diversity has special significance. This is recognised in a National Strategy and warrants the increased community support and resources that it is receiving.

Weeds are one of the major threats in conservation and hence the current rapid increase in the recognition of environmental weeds - weeds whose impact is solely or partly on natural ecosystems. Weeds are well recognised by the National Strategy for the Conservation of Biological Diversity and targets are set for the development of species-specific management plans and the number of successfully controlled species. At all levels of scale, the conservation impact of weeds needs to be addressed. However, in doing so there will be pay-offs in attracting resources - whereas conservation benefits were once a spin-off from production-based funding, now there will be situations where the reverse occurs.

Local ownership of issues

Local ownership means involving local individuals or groups in the decision-making process and the subsequent actions. Local ownership is of such importance that it is one of nine principles of a sustainable society (IUCN/UNEP/WWF) - *"Most of the creative and productive activities of individuals or groups take place in communities. Communities and*

citizens groups provide the most readily accessible means for people to take socially valuable action as well as to express their concerns. Properly mandated, empowered and informed, communities can contribute to decisions that affect them and play an indispensable part in creating a securely-based sustainable society."

The Queensland Department of Lands received a Treasury initiative in 1992-95 which provided funds for control co-ordinators and strategic control operations (herbicides and equipment). In the course of implementation there was consultation with Shires, local landholders, Landcare groups and local staff of State Departments. This resulted in a commitment to projects and additional resources of labour and equipment from these parties demonstrating the benefit of local ownership of activities. It is also intended that local ownership will result in maintenance of sites to control seedlings or other regrowth.

Readily available information

Information is essential in weed management at all levels of scale and for all activities - control operations, planning, policy development, extension and research. Furthermore, information needs to be readily available.

Information needs include National and State Strategies; all catchment, county council, regional or local government plans; state-wide species plans; legislation and policies; description of biology, distribution; declaration status and control methods for all weed species; standard extension brochures and major workshop reports. All of this information could be made available via a computer-based information system.

The species distribution both present and potential, should be on a geographic information system (GIS) so that it is graphically presented and can be analysed in relation to other layers of information (e.g. boundaries, climate and soils). The system should also be capable of linking to local government/county council systems recording weed control inspections, operations and serving of notices.

How much information is not even known to each of us? How much time is wasted trying to find your copy of documents?

We are constantly reminded that this is the information age. Weed management must be a part of it and the above proposals are all technically feasible.

Objectively based decision making

In the management of noxious weeds, there is often pressure applied on government agencies by community, industry or special interest groups to declare a species, provide subsidies, or conduct control operations. Demands for action usually arise from one group but are commonly supported by many neighbouring groups. The concern is usually genuine, but is narrowly focussed on one species, in one part of the State, and at one point in time.

Decision making in response to the pressure can lead to distorted priorities and wasted resources by attempting non-achievable objectives.

In response to these situations, and in any case to support sound decision making, there needs to be a process of objectively assessing a species or issue, using available technical information.

Community awareness

Australia is largely an urban society, so urban community awareness of weeds is vital for several very different reasons:

* it follows from the above, that the majority of tourists are from urban areas, and with the assistance of 4WD vehicles, are visiting all of Australia's ecosystems. An awareness of weeds is important in seeking compliance with any quarantine or washdown requirements.

* at least some of our future weeds are still in the gardens and aquariums of Australia. Community awareness is necessary in avoiding dumping of garden rubbish in bush areas, and avoiding distributing and growing invasive plants, either from cuttings or purchases from nurseries and aquarium shops. Urban community support will also assist the implementation of the precautionary principle and so restrict the introduction to Australia of species which could be invasive.

* the urban community has a dominant role in the political process and thus ultimately urban support is required for the allocation of resources to weed management.

Whole systems approach

A whole systems approach means addressing the whole of the system; the scale may be at the property, catchment or ecosystem level. In research, a system may also range from a single leaf to the earth (Hynes and Scanlan 1993). Scale also includes a time dimension. The systems approach means careful identification of the components of the system and their relationships. This means considering all requirements and consequences of weed management - farmer or community goals (eg. commitment to completing a project), resources for a permanent reduction in weed impact (eg. the need for follow-up action), causes of the problem which if unchanged may lead to reinvasion, and consequences such as the need for revegetation, dead woody weeds blocking creeks or invasion by another weed.

Maximising resources

The financial, labour and physical (equipment) resources available to weed management is larger than readily obvious, although complex. Limited financial resources above base funding can be accessed from the Commonwealth Government (e.g. Drought Landcare) and may be available from State Government initiatives.

Labour is available through a wide variety of sources - employment and training programs, prisoner work schemes, volunteer groups and from co-operation with landcare and bushcare groups, landholders and staff of government agencies. Equipment can be directed to weed management through co-operation with groups, landholders and other government agencies.

In seeking to maximise resources, the principle of readily available information (for funding and labour programs) and local ownership (to achieve cooperation) are essential.

Quality management

Although this is one of the current "buzz terms" of management, it does have a real value for weed management. Exotic weed management involves legislation, declaration of some species, specified levels of control, provision of assistance in some cases (herbicides, equipment), restrictions on movement of declared plants (or plant parts or seed), and operations involving local government and landholders. For efficient and effective weed management, all stakeholders (employees and landholders) must know what they are to do, how it is to be done and who they report to; all necessary equipment, instructions or information must be available. A quality management system will meet these needs.

The legislation for weed management is the responsibility of state departments, so responsibility for quality management starts at this level. The requirements of the department for what is to be done must be clearly documented and available in the forms of policies, procedures, guidelines, model plans and forms.

Training

Effective weed management can only be fully achieved with skilled staff, from corporate policy officers and research scientists to field operators. Staff must be skilled not only to ensure the obvious benefits in efficiency and effectiveness, but also to ensure safe working conditions and no adverse consequences of activities (e.g. herbicide residues or spray drift).

Training should be competency based in accordance with national standards, that is focussed on what is required broadly of an employee in the workplace and what a person can do as the result of the training.

RELATIONSHIPS OF WEED MANAGEMENT PLANS

Weed management plans can be classified on two attributes:
1 **Scale** ie. address issues at a national, state, regional or property level.
2 **Scope** ie. comprehensive weed management versus single species.

The relationships of the two streams of comprehensive and single species plans at the different levels of scale are illustrated in Figure 1.

Weed management plans must contribute to and be consistent with plans for wider components of natural resource management and in some cases organisational Corporate Plans; the relationships are shown in Figure 1.

Natural resource management and organisational plans.

At the highest order are plans which address issues across all industries and communities Australia-wide - the National Strategy for Ecologically Sustainable Development and the National Greenhouse Gas Response Strategy.

At the next order down are the sectoral national strategies which are more specific. These have a widely varying basis - climate determined area (rangelands), vegetation class/production system (forests) and conservation (biological diversity). There are other national strategies but these are ones that include weed management.

At progressively lower orders are State-based strategies, Regional/Local strategies or plans (e.g. catchment strategies, South-West strategy for the mulga region of Queensland, corporate plans for local governments) and property management plans.

Weed management plans - species specific.

National weed species plans address the management of a species Australia-wide. There are no plans developed for established species but the kochia (*Kochia scoparia*) and Siam weed (*Chromolaena odorata*) eradication plans could be considered as examples; they are approved Australia-wide (through the Standing Committee for Agriculture and Resource Management) and funded by AQIS and the States at risk.

State weed species plans may either address a State's component of a national species plan, and must be consistent with the national plan, or address a state-based priority species. An example of the latter is the Strategic Plan for the Control of Harrisia Cactus in Queensland. This plan was developed by four representative landholders, the Chairman of the Rural Lands Protection Board and departmental staff. It follows a model strategic plan format with goals, strategies and actions. After consultation with industry groups, it was publicly launched. Another example is the Serrated Tussock Strategy for Victoria.

The lowest order of weed species plan is at the property level. This plan is particularly useful for addressing enforced control situations, whether for eradication, for quarantine restrictions, or for management of well established weed populations. The last situation provides a dilemma for both the landholder and the regulatory authority. Tackling a well established weed with regular notices for incremental control is fraught with difficulties - it creates an antagonistic relationship, ownership of the problem remains with the authority, landholder is not motivated, landholder may not have the resources to do all the work, and timing is set by the authority and may not suit farm operations. This situation occurred for the control of Harrisia cactus in Queensland, using the mealy bug which must be collected and distributed. A scheme of property management plans for Harrisia cactus is now operational. A proforma has been developed and workshops are run to guide landholders through the process. Landholders use their own aerial photographs or are provided with a property map. A computer based record of the cactus distribution and planned actions is kept by the Department. The plan is formally approved, followed by the lifting of the control notice.

Weed management plans - comprehensive

State weed management strategies are the first order below the National Weed Strategy. All States and Territories except Queensland and Victoria are developing or planning to develop a state weed management strategy. The Tasmanian Weed Management Strategy, titled "WeedPlan" is the most advanced, being at the final draft/public consultative stage (WeedPlan 1995).

WeedPlan aims to co-ordinate and integrate the available weed management components to minimise the deleterious effects of weeds on the sustainability of Tasmania's productive and natural ecosystems.

These key components are:

co-ordination
roles and responsibilities
resources
quarantine and hygiene
which weeds where?
weed control measures
legislation
other plans
monitoring and evaluation

The plan uses a creative approach of pictorially assigning each component to a jigsaw piece, with the pieces fitting together to form Tasmania. The jigsaw theme is continued through the plan. The plan addresses all ecosystems, terrestrial and aquatic (both freshwater and marine), and is a model for other States and Territories.

Below state plans are regional and local plans. The area basis for these plans may be defined in one of several ways [e.g. Tamar Valley Weed Strategy (WeedPlan 1995)] geographic [West Coast Weed Strategy (WeedPlan 1995)], biogeographic or administrative (e.g. local government, county council). In Queensland the planning focus is on the administrative unit responsible for declared pest control, that is, local governments. They are responsible for controlling declared pests on land under their control, inspecting private property, providing advice and ensuring control on private property. Local governments provide the resources for these responsibilities.

The Rural Lands Protection Act addresses pest plant and animal management and stock routes operations. Thus land protection planning involves a Pest Management Plan (weeds and pest animals) and a Stock Route Management Plan. The planning process is still in a developmental phase. A resource kit has been developed to guide a collaborative approach in each local government, involving elected and staff representatives and local Departmental officers.

Currently, each local government sends its annual budget funds to the Department, along with other levies, and the funds are returned on a claiming basis as work is performed. It is proposed to introduce annual Ministerial approval of local government pest management plans. Funds will not need to be forwarded to the Department under an approved plan, resulting in a shift of ownership and responsibility to local governments and administrative savings (in addition to the other benefits of planning).

While weed management planning is still in its infancy there are few, if any, regional/local plans on a different area basis which overlap i.e. a catchment plan overlapping an administrative based plan. If regional/local planning was taken to the ultimate, there would be three or four plans addressing any one area. This may require rationalisation, although catchment plans will tend to address a larger area than local government plans and thus

be a higher order plan. Flexibility should be retained with plans prepared only to address clear needs and objectives.

Property weed management plans are the next and lowest order. For private landholders, weed management would normally be incorporated into their overall property management plan. This order of plans also includes government agencies, local weed management plans e.g. Forestry, National Parks and transport corridors.

For well established weeds, these areas are sometimes a source of re-infestation for adjoining landholders, yet being State agencies, cannot be forced to implement control. It is proposed in Queensland, that these agencies be strongly encouraged to openly and collaboratively develop plans which balance stakeholder needs and resources, and which are consistent with the local government plan for the area.

QUEENSLAND INITIATIVES

In addition to Local Government Pest Management Plans and property single species plans (outlined above), the following programs are recent initiatives in Queensland. They address the principles and are proposed as major components of weed management towards 2000.

Potential weeds management

The Department of Lands has implemented a comprehensive approach to potential weeds (outlined in Csurhes and Bielby, 1994). In 1992, the position of Exotic Species Officer was established, with the primary responsibility of potential weeds management. Key activities have been:

Establish a database of potential weeds of Queensland. The database includes species not yet in Australia, in Australia but not yet in Queensland and in the early stages of establishment in Queensland. This database provides the basis for evaluation and decision-making on each species.

Declare species with the greatest potential impact to provide the power for immediate action if any are detected in Queensland, to prevent sale and to assist in promoting awareness.

a) A procedure for reporting by herbaria, of any plant species which are identified for the first time in Queensland. The exotic species officer then investigates the species for its weed potential.

b) Increase awareness of potential weed species and how they can be transported to Queensland. There is still much to be done to ensure that the right people are fully aware of even the key potential weeds and how to recognise a species they have not seen before.

c) Conduct investigations of plant species and make control and policy recommendations based on their potential to be invasive weeds.

Pest status assessment

Pest status assessment is a process for maximising objectivity in decision-making and avoiding decision-making in response to special interest pressures. It is species based, with priority given to species where there is:

a) a high level of uncertainty on future directions.
b) a current or potential high impact on resources.
c) high public demand for action

New declarations of weed species or significant changes to declarations now depend on completion of an assessment. An assessment is conducted by a team of staff with relevant expertise. They review published and unpublished information to provide a draft report which addresses:

a) taxonomy
b) biology and ecology
c) current distribution and impact
d) potential distribution and impact
e) current management methods
f) history of spread and management
g) information gaps requiring research
h) feasibility of preventing spread and other management options.

The process involves a workshop of the team to commence the review, and a workshop of the team with management to develop the recommendations based on the draft report. The final report is submitted to the Rural Lands Protection Board for advice on the recommendations and will in future be published as an internal report.

The pest status assessment then becomes the basis for development (or review) of the species policy and a state strategy for the major weed species.

Urban awareness of weeds

To address the principle of community awareness of weeds, Queensland initiated a three year project to address "Urban awareness of weeds" (funded by the National Landcare Program). The project originated from Land Protection Branch strategic planning and a Queensland Landcare Council Working Group. The project has resulted in a "Weedbuster" logo, a "Woody Weed" live character (costume worn by volunteer), an annual weed awareness week (or day), urban weed brochures and an extensive media campaign. The project will contribute to a weedbuster kit for schools (still to be developed).

In the lead-up to Weedbuster Day in 1995, staff were interviewed on radio programs and on prime-time current affairs television programs. The Weedbuster Day featured community groups in urban weed control.

Another component of the project has been focused on the sale of invasive plants by nurseries and their use by professional landscapers. A survey of weed awareness by nurseries has been completed by a consultant. Liaison with the nursery and aquarium

industries has been established. The Department will improve awareness by supplying brochures and articles to newsletters published by QNIA.

Policy development

Policy is defined in legislation, regulations and policies. Policies, which define what the government will do or require, and procedures or guidelines, which define how actions are to be done, are a part of quality management and a requirement under freedom of information. Previously, the requirements for declared weed management in Queensland were conveyed via the category of declaration and records of decisions made by the Rural Lands Protection Board. Policies are now being developed for each species, including species not declared, and for associated management issues, such as the level of required control. The policy development process involves consultation with field staff, an advisory Board (Rural Lands Protection Board) and a departmental management group before forwarding to the Minister for approval.

Strategic weed control

The Department of Lands commenced a strategic and preventative weed control program in 1992, as a three-year Treasury initiative. The funding of $600,000 per year provided for six field staff, three vehicles and operating costs, primarily herbicides and diesel (for basal bark application of herbicides). The staff were based at three or more centres, with flexibility to assist on major projects as required. A project leader was responsible for managing the prioritisation of target species and the areas to be treated.

Objectives for weed species were established in line with Departmental policies - eradication of honey locust tree *(Gleditsia triacanthos)* and containment of other species by control of outlying infestations (e.g. prickly acacia, rubber vine, blue thunbergia). In addition, when Siam weed *(Chromaleana odorata)* was first detected in Australia, this program provided the core resources for an emergency response. The program has also supported potential weed management with control of barleria *(Barleria prionitis)* at Townsville and Senegal tea plant *(Gymnocoronis spilanthoides)* in South-east Queensland (in progress).

A feature of the effectiveness of this program has been its role as a catalyst for attracting other resources. Projects have used Australian Trust for Conservation Volunteers (ATCV), prisoners in work schemes, participants in employment and training programs, local government officers and landholders. This has been possible because the program provided the planning, supervision, consumables (herbicides, diesel) and equipment.

The strategic approach, combined with the benefits of local ownership of the activities and maximising the application of other resources, has proven successful. This success has led to a continuation of the program as a part of base funding and the commencement of a new three year initiative for $1.5M per year.

Pestinfo

Pestinfo is a computer-based pest information system currently being developed by the Department of Lands. The objectives are:

a) To have information on current pest distribution readily available for policy, planning, monitoring and impact assessment purposes (at all levels of scale from property to state-wide).

b) To monitor changes in pest distribution (including the results of control programs)

c) To provide an efficient system for recording field inspections.

d) To use current pest distribution data to develop models of potential distribution.

At present, information is collected on an ad hoc basis by Departmental control services, extension and research staff, and by Local Government staff using a range of survey methods, and with no central collation. The information is thus difficult to access.

The first phase of this GIS-based project will allow field staff to record data using GPS co-ordinates (i.e. the weed infestation can be accurately mapped) or simply presence/absence at a property level. Staff will record data directly into a laptop computer in the field, and later transfer this to a central computer.

My vision of Pestinfo is that it will ultimately be an even more comprehensive system by including - all local government and other pest management plans, current control methods, summary of biology/ecology, Departmental policies, potential pests database, and Departmental species files (for limited access).

The system has the potential to greatly improve the efficiency and effectiveness of pest management, by quick access to information, improved corporate decision-making and improved local or regional decision-making.

ACKNOWLEDGEMENTS

The innovative weed management programs described for Queensland have been developed by many staff of the Department of Lands.

CONCLUSION

Weed management has changed a great deal in the last five years. It has been affected by external changes ranging from the rapid recognition of the importance of weeds in sustainable land use and nature conservation to the need for governments to be accountable (measured by efficiency, effectiveness, outputs and outcomes), the increased number and involvement of local community groups and changes in technology, particularly information technology.

Weed management is responding to these changes in a variety of ways, through planning, preventative weed management, strategic control involving community groups, mapping and information systems, and increased priority to environmental weeds. However, enormous challenges remain. Creativity, motivation, leadership and communication are required to develop new or improved components of weed management - many further changes are required in the next five years to 2000, if we are to achieve major progress towards sustainable land use and the conservation of biological diversity.

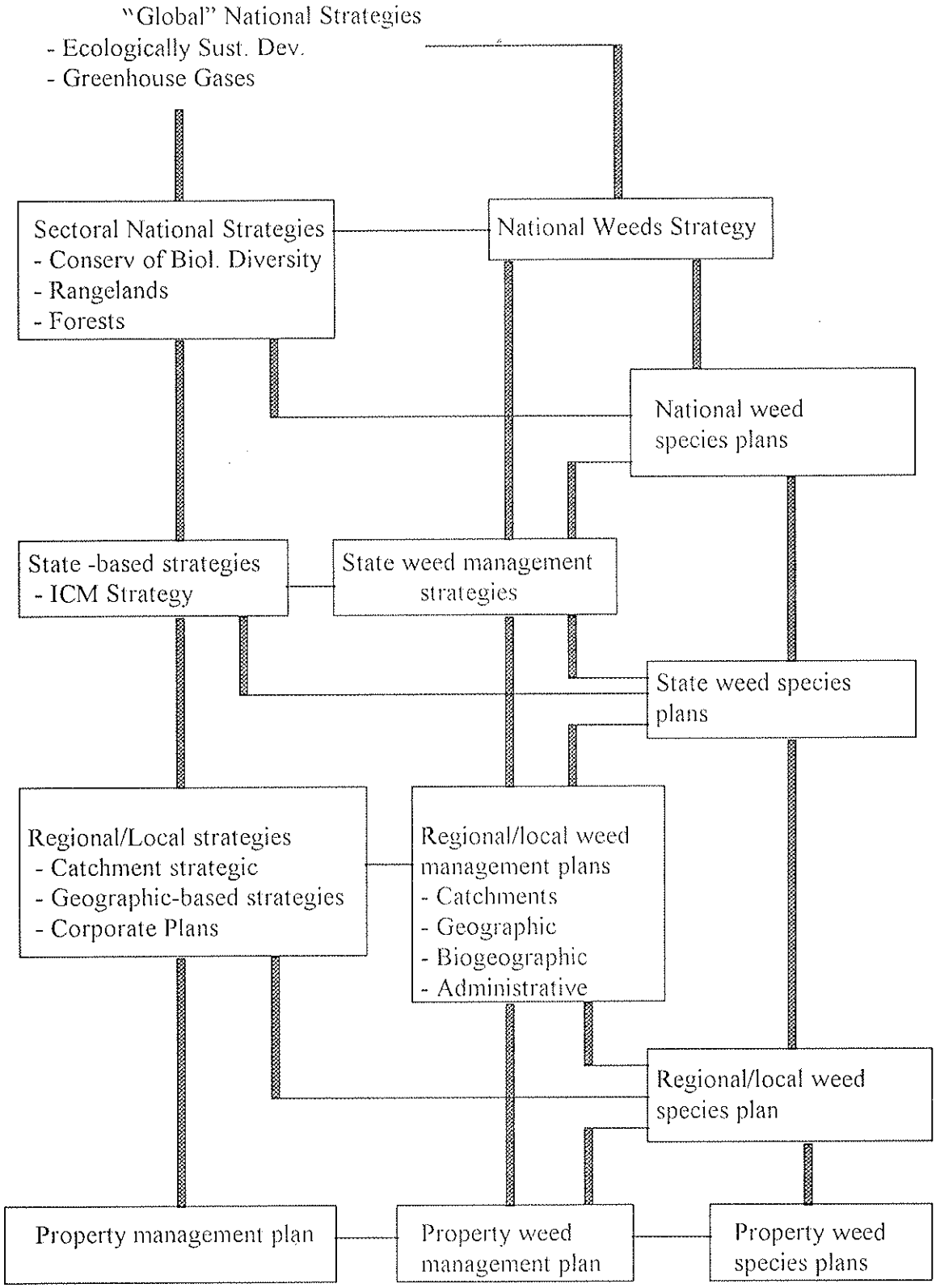

Figure 1: The scale scope and inter-relationships of weed management and natural resource management strategies/plans.

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MANAGING VEGETATION IN AN URBAN ENVIRONMENT ON A CATCHMENT BASIS

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Introduction

It can be argued that management of vegetation is important everywhere, but particularly in urban areas where human impacts are so dominant. In this paper, I shall outline a process that has been undertaken by the Hawkesbury-Nepean Catchment Management Trust to develop a framework for managing vegetation within the catchment - which includes not only urban environments but also peri-urban and rural environments.

The Hawkesbury-Nepean catchment covers some 25,000 square kilometres extending south from the Hunter Valley to Lake George and west from the Sydney basin to beyond Lithgow, and is home to about a million people. The river system draining this vast area is long and complex, comprising not only the Hawkesbury-Nepean but also the Wollondilly, Wingecarribee, Cox's, Colo and Macdonald Rivers and Mangrove, Mooney Mooney, Berowra and Cowan Creeks and their tributary streams. The vegetation types of the catchment are diverse, including forests, woodlands, grasslands, swamps and other wetlands, salt marshes amongst others, as well as those associated with our cultural heritage. The term vegetation encompasses also the great variety of plant species present in the catchment, together with the range of different communities that they make up that are found in a multitude of habitats, both wet and dry, from the mountain tops to the coastline and estuary.

In setting out any proposals to manage vegetation there are some obvious essentials:

1. The current situation and conservation of the vegetation need to be assessed, the current impacts determined, and whether or not management is needed.

2. Plans need to be made to conserve, restore and enhance the different vegetation types and plant communities and species within each type.

3. Everyone needs to be involved in the planning and decision making process.

4. Everyone needs to agree to act; resources need to be found and the action needs to be coordinated so that it is effective.

The Current Situation

Current vegetation status

It is estimated that some 65% of the catchment remains forested, but many of these forests are degraded in both structure and composition, and other parts of the catchment have been almost completely cleared. Figure 1 provides a very general perspective of the current status of vegetation cover within the Trust's area of responsibility (about half of the full catchment).

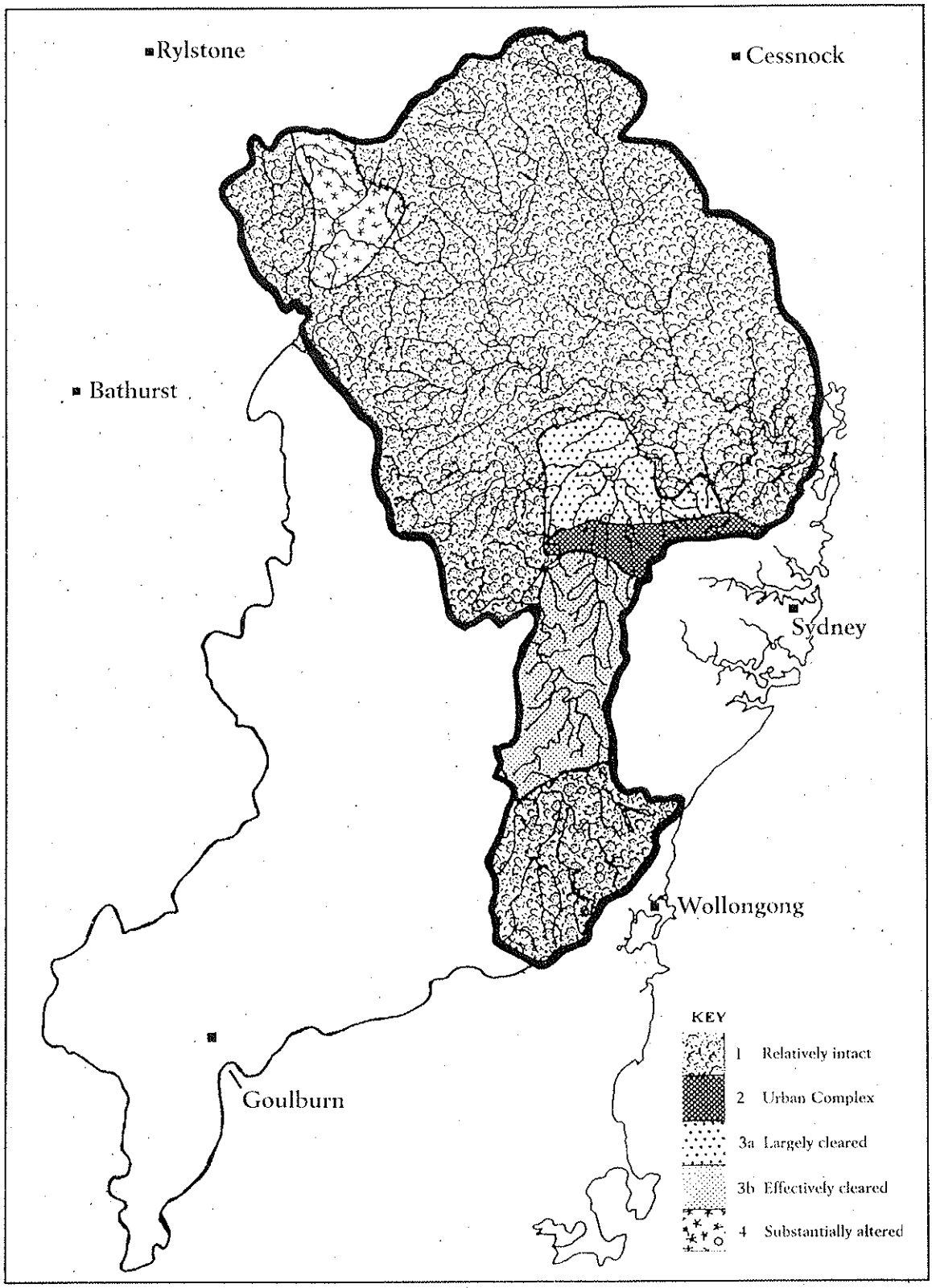

Figure 1 - Status of Vegetation in the Hawkesbury-Nepean Catchment

At one end of the spectrum we have the 'urban complex' where the original vegetation has been cleared, either for past agriculture or more recent urbanisation. Because the principal land uses of the fully developed urban areas are residential (houses and gardens), industrial, commercial and business, together with public infrastructure (provision of roads, drainage lines, power and Sewage systems, etc.) and open space (parks, playgrounds) the vegetation is often predominantly exotic, but there are a range of situations from that extreme to the urban-fringe situation where patches and corridors of remnant native bushland remain close to the urban areas.

At the other end of the spectrum is the "relatively intact" map unit; this includes the national parks, nature reserves and protected water catchment areas of the Hawkesbury-Nepean system with their range of native vegetation types. Much of the vegetation of this category has, in fact, been altered by changes in fire regime, by previous and on-going forestry and grazing, and some relatively large areas within it have been cleared for grazing. These are not indicated because of the map scale.

In between are the map units that indicate that vegetation has been "largely cleared" or "effectively cleared" for primary industry and more recently for rural residential purposes. The former indicates areas where there has been large-scale clearance of the understorey which has resulted in non-regenerating tree cover over semi-natural pasture; some intact remnant vegetation patches may be present. The "effectively cleared" map unit covers areas that retain very few remnants of the original vegetation and these are surrounded by highly altered landscapes such as improved pasture, plantation forestry and intensive agriculture.

It has also been well-documented that riparian areas are in a very degraded condition and many wetlands have been drained. Only a small percentage of the original vegetation types of the Cumberland Plain remain, and although there are a number of national parks within the catchment they are predominantly in sandstone areas and the full range of ecosystems (plant and animal communities and habitats) are not represented by the current system of parks and reserves.

Current impacts

Within urban areas the main impacts include further clearance or alteration of remnant bushland patches and vegetation corridors, with concurrent loss of biodiversity; the intrusion of exotic plants and weedy species into the remnants, and the effects of polluted water in stormwater run-off and sewage effluent. Domestic animals also impact on remnant bushland areas and on wildlife within them. Impacts associated with recreation and with the reduction of bushfire hazard are also important in all urban and peri-urban areas.

Clearance and fragmentation of larger areas of vegetation are probably the most important impacts in the peri-urban and more rural sectors and often lead to increased soil erosion and sediment transport in stormwater run-off. They also result in a loss of biodiversity and amenity, and enhanced greenhouse effect. On-site sewage disposal and agricultural practices (intensive livestock; erosion of river and streambanks) also adversely affect native vegetation in these areas. Direct and indirect exploitation of individual species affects the structure and composition of the plant and animal communities present and may result in changed habitats that allow weedy species and animal pests to establish.

Current management and management needs

Large areas of the catchment are owned by the state government and managed by state government agencies, and other by local government; some is the responsibility of the federal government and the remainder is in private ownership. Current management is based on a series of legislative and planning documents applicable at all levels: state, regional and local.

The public has a major role to play in the management of the vegetation resources of the catchment. They are the principal users and beneficiaries of the vegetation. The "health" of the catchment is dependent upon strong and viable plant communities as they support or influence many of society's effects upon the environment.

The Trust's role is in coordinating the management of natural resources within the catchment. The Trust's mandate is to:-

a) encourage the protection, and where appropriate, restoration of the Hawkesbury-Nepean River system (within the defined Trust area),

b) facilitate the ecologically sustainable use, development and management of natural resources, the floodplain and the built environment; and

c) foster orderly and proper physical, environmental and socio-economic planning and management as a basis for the well-being of the people and all life within the catchment.

Why do we need to manage the catchment's vegetation?

Very simply - because of its great value to us. The values of vegetation are well documented: in urban areas plants improve parks, streetscapes and property values, and remnant natural vegetation provides living space, shelter and food for urban wildlife, an educational resource, protects soils from erosion and assists in controlling the quantity and quality of water reaching watercourses. In peri-urban and rural areas throughout the catchment vegetation also enhances scenic quality and amenity, provides a scientific resource and a range of tourism and recreational opportunities; provides shade and shelter for farm animals, habitats and corridors for movement of wildlife and reduces groundwater levels and salinity in groundwater. Plants provide us with a variety of crops, food for livestock, and many other useful products: food and drink, oils, gums and resins, timber, fibres, ornaments and medicines.

Vegetation also plays an essential role in maintaining the naturally functioning systems that ensure a balanced 'web of life' and through that, environmental health. When natural systems become unbalanced the costs are high; they are indicated by the costs of crop losses, of algal blooms, of public health risks. So it makes good sense to conserve and manage vegetation so that it continues to protect our land, to assist in the maintenance and improvement of the quality of our air and water, and to provide resources for the future.

But also, it is important to act now, because of the way we have used vegetation in the past and continue to use it. Vegetation is one of the catchment's main renewable natural

resources. But the amount of natural vegetation that has been lost over the past 200 years of European occupation, and that continues to be lost today through clearing and various other impacts, must be of concern to us all. That loss is now widely recognised as a significant cause of land and water quality degradation. It is essential that action is taken quickly to conserve as much of the remaining native vegetation within the catchment as feasible and manage it in a sustainable way.

Planning for management

How can we best conserve and manage the catchment's vegetation?

What do we mean by the terms 'conserve' and 'manage'? Both words embody the concepts of *careful use* and *protection and preservation* of resources. And these concepts are also embodied in the concept of 'total catchment management'. But also the great value of the community and government working together is recognised in this concept. Total catchment management (TCM) aims to achieve sustainability of natural resources through coordinated and cooperative management on a catchment basis.

To achieve sustainability we have to balance our use of resources such as water, soils, vegetation and biodiversity with their protection and preservation -- or, in other words, conserve our resources. Currently, we are using such resources at a faster rate than they can be renewed and we have to find ways in which we can redress the imbalance. We also have to reduce the adverse effects that many of our activities have on the environment.

By everyone learning more about the different types of vegetation in the catchment, understanding their value and working together, we are more likely to ensure that the vegetation resource is retained, and where necessary restored and enhanced for future use and enjoyment.

Why a catchment base?

We all live in a catchment - defined as the land area from which water drains to a common watercourse - and this is a good natural unit with clearly defined boundaries to think about when considering how best to use our land and water and manage our vegetation resource. One of the main values of considering vegetation on a catchment basis is that it promotes a broader view and consideration of others. Catchment aspects are important - whatever is done at the head of the catchment will affect the bottom; impacts on upstream areas will affect downstream areas and so on. While individual plant species, communities and vegetation types are often widely distributed, crossing many different catchment boundaries, their local distribution often relates to topographic position (ridges, slopes, valley floor or floodplain), to aspect (east, north, west or south-facing slopes), to specific soil types (gravelly, sandy, clayey or humic soils), or ground water table levels (low, high).

Also, when planning further development for urbanisation of vegetation for other purposes catchment landscape aspects and plant community distributions should be considered - what areas need to be conserved or protected, eg. ridgetops and steep slopes because they have highly erodible soils, wetlands and riparian vegetation because of their ability to assist in the control of water flow and value in improving water quality; a range of

vegetation types to provide for plant and animal diversity, and for recreational purposes and so on. The geographic base of the catchment remains useful as a descriptive unit.

Involving Everyone

The participatory process

From mid-1994 the Trust has been coordinating the development of a framework for managing vegetation within the catchment using a participatory process. A steering committee was formed comprising representatives of state and local government authorities and community representatives. It ran a series of workshops to gain an understanding of the key issues affecting vegetation in the catchment and to develop the framework for a management strategy. The workshops involved some 60 people representing the community, government agencies, local government, environmental groups, local interest groups and individuals with experience relevant to the management of the aquatic and terrestrial vegetation of the catchment.

Setting a goal

The framework was designed to provide a set of identified policies, aims and actions that would encourage consistency in planning and improved management of terrestrial and aquatic vegetation throughout the catchment. It is essentially a framework that allows for the development of more detailed and specific plans relevant to all areas of the catchment.

The agreed goal for the catchment's vegetation is:

> ***For the community to retain, rehabilitate and manage vegetation which protects plant and animal species diversity, soils, water quality and public amenity and ensures the maintenance of ecological processes.***

Priority issues

The key conservation and management issues that were identified were the need to conserve and manage nature, land and water, but also the need to consider social and economic aspects. It was recognised that all these aspects had to be integrated if sustainability was to be achieved. The framework included under each of these key issues a series of policies, aims and actions. These were defined as follows:

Policy	a course or general plan of action adopted and pursued
Aim	that to which action is directed; to seek to attain
Action	the work to be done; the process of acting or influencing

The various actions were linked to both a timeframe (within 2-3 years, 4-6 years, ongoing) and to stakeholders: those authorities with both statutory responsibilities and advisory roles. Local government and non-government organisations, specific interest and other community groups, and individuals all have a role to play in the implementation of the framework.

Those participating in developing the framework considered it was essential to retain and restore areas of conservation value throughout the catchment for protection of land and

water, to conserve plant species and their genetic diversity, together with a full range of vegetation types and their habitats; and to attempt to reduce human impacts which adversely affect the vegetation. It was agreed that in order to do this: information of the current status of the catchment's vegetation needed to be collated, the pressures being exerted upon it identified and responses to those pressures developed. Sound management practices for the various land uses within the catchment needed to developed and implemented as they would be of value to everyone. Implementation of the improved management practices could be encouraged through direct economic incentives. A sense of responsibility for vegetation management and increased community involvement in that management was needed; increased information about the vegetation resource in the catchment and its value would assist in developing these aspects.

It was believed that improvements in the catchment's vegetation and environmental quality will also have follow-on effects, such as providing increased recreational opportunities and enhanced heritage values and employment opportunities as well as increased economic returns for all involved in using the land.

Public consultation

The Trust endorsed a draft vegetation management strategy in late September 1994 and the document was initially circulated to government agencies and councils for consideration and comment, and revised in the light of their comments prior to being released for broader public comment. The framework document, together with an informative brochure, was published in April 1995 and placed on Public Exhibition until 31 July 1995. Copies were exhibited at Council Libraries, local offices of state government agencies and at Catchment Management Committee (CMC) offices as well as at the Trust office. Advertisements were placed in local papers calling for comments and giving dates of public meetings. Both were also made available at the Trust's Public Forum in early May.

Seven meetings held throughout the catchment during June and July provided the opportunity for presentation and discussion on the vegetation management framework, and the community were encouraged to submit their comments on the draft to the Trust. Attendance at all meetings was very good and the discussions lively. Notes were taken at each of the meetings of the comments, concerns and issues raised. Some 48 submissions based on the brochure and 57 written submissions on the full document were received, the latest in October, 1995.

Revising the framework

The comment received were collated and the draft framework reviewed in light of them. All contributions were welcome and given due consideration. Generally, the submissions were favourable indicating support for the process, and the comments and suggestions made were helpful and constructive. A summary report of the submissions entitled 'What you said: report on community consultation on *Time for Action: Draft Framework for Vegetation Management in the Hawkesbury-Nepean Catchment*' has been published and is available from the Trust.

The framework has been revised on the basis of all comments received. Almost all duplication has been removed and suggested actions are now grouped into related series

under a few main aims and policies, namely those perceived as having priority by the community. Stakeholders have now been included under the aims rather than the actions (again reducing duplication) and timeframes have also been left out of the revised document as priorities will vary from one part of the catchment to another. It is important that timeframes are not forgotten when developing more detailed action plans for specific areas, as they provide a way of setting priorities. Experience indicates that it is important to meet priorities and very satisfying to achieve results within a certain timespan, especially when projects may run over a number of years.

The framework is divided into two parts: conservation and management of the vegetation resource, and social and economic aspects. The policies in the first section include:

- Provide accurate up-to-date information to the community on all aspects of vegetation and its conservation within the catchment.
- Conserve the diversity of indigenous vegetation types, plant communities and species throughout the catchment.
- Conserve the health and viability of aquatic ecosystems through the maintenance of the catchment's vegetation.
- Provide a comprehensive and consistent body of legislative and management controls to conserve vegetation.
- Vegetation conservation and management issues to be fully addressed in land use planning and development processes.
- Provide comprehensive and coordinated conservation of the catchment's vegetation.
- Increase information on vegetation within the catchment.
- Coordinate vegetation studies and activities through improved monitoring and reporting back to authorities and the community.

The policies in the second section include:

- Increase the involvement of the many different sectors of the community in vegetation conservation and management.
- Recognise that vegetation and its management are important components of the cultural heritage of the catchment.
- Recognise and promote vegetation and its conservation as economically beneficial.
- Increase the effectiveness of funding and services relating to vegetation management in the catchment.

A number of the submissions the Trust received to the draft framework indicated a desire for much more detailed action plans to be provided. This is considered inappropriate within a framework document which is designed to provide a more general base that will allow for flexibility of approach when developing more detailed plans and actions to address specific and local issues. The framework is only one part of the process and has to be implemented.

Getting Action - Implementing the framework

The final part of the process is to get some action, that is, to implement the policies and actions outlined in the framework. The Trust has recently agreed to publish the framework document and make it widely available. To assist in the implementation of it, the Trust is encouraging and coordinating the preparation of a variety of guidelines that will provide

more details on how to undertake many of the series of actions suggested within the framework, and has also coordinated the preparation of some resource documents. These will be published when completed and will be available at the Trust and Catchment Management Committee offices.

How can the framework and associated documents be used?

As well as providing a set of catchment-wide policies, aims and actions that will encourage consistency in planning for the conservation and management of vegetation, the framework and associated resource and guideline materials can be used in many other ways. They will provide a sense of direction to decision-makers and the community and a forum for involving the whole community in promoting positive action and change in managing the vegetation resource. In setting courses of action there can be consistency of approach and cooperation between all parties involved; individuals, groups, councils and government agencies can work together. Positive changes will result with an increase in community support and commitment.

Decision-makers will have a list of potential priorities for management within local areas and a sound basis for deciding which areas of vegetation should be conserved, which further areas could be cleared without damaging flora and fauna habitats and reducing biodiversity, and which areas are most in need of rehabilitation. The framework and guidelines may be examples that can be used in other catchment areas.

The framework and associated documents will also provide a basis for: increasing awareness of the value of vegetation amongst the community; the development of more integrated and efficient management controls; coordinating vegetation management between departments within councils, agencies and other multi-purpose organisations; and developing cooperative vegetation management programs with neighbouring councils. There can also be increased accountability. The framework and guidelines will provide a basis for setting performance standards, for increased effectiveness of existing control mechanisms, and a yardstick against which to measure change.

The resource documents will assist in answering public inquiries, in developing applications for funding of surveys, rehabilitation and regeneration projects, and provide reference material adapted to suit specific local areas.

Who can use these documents and act? - the stakeholders - who are they?

Everyone who is involved with the catchment: individuals whose activities impact on the catchment's environment, landholders, community groups who have an interest or work within the catchment, those who focus on conservation of heritage or flora or fauna, on recreation or education within the catchment, industries and businesses, and the many authorities, non-governmental and governmental who have advisory and/or legislative responsibilities within the catchment.

Individuals can be active in vegetation management. We can appreciate the colour, form, size and shape and the enormous variety of our Australian plants, plant communities and vegetation types and assist by replanting trees, shrubs, and smaller ground-covers locally to bring back the bush and attract native birds and other wildlife. The loss and degradation of the local and catchment vegetation will affect many of our own activities so we may

become involved by attending public meetings where vegetation issues are discussed, or by writing letters to decision-makers about our concerns.

There are many different non-governmental and groups in the community that are interested in the conservation of vegetation in the catchment: the environmental groups, the bush regenerators, Streamwatch groups, Trees for Rotary, Men of the Trees, Progress Associations and the various Volunteer groups amongst others. All are playing and will continue to play a very important role in the retention, rehabilitation and enhancement of the catchment's vegetation.

The industrial and business sectors are extremely important to vegetation management in all areas of the catchment. They have a role to play in improving general amenity on their own properties through rehabilitation, and can assist with experimental and demonstration sites, in broad-scale education, and in developing new plant products.

Local government is the closest level of government to the community. Much of the conservation and sustainable management of the catchment's vegetation lies in their hands. Local councils, in carrying out their own activities and in directing those of others, are very much a key player.

The Federal government owns significant areas of the catchment. The framework provides the Federal government with an outline for vegetation conservation and management for their own lands. It also provides a basis for Trust and community submissions on Federal government initiatives.

There are many State government agencies involved in the overall management of vegetation in the catchment. There are the obvious ones such as NSW National Parks and Wildlife Service, the Department of Urban Affairs and Planning, and the Department of Land & Water Conservation. But there are also many others that have direct or indirect responsibilities in vegetation management and these are listed in the framework document; all can be involved in the implementation of *Time for Action,* providing advice, information and assistance in developing more detailed action plans.

The Trust in its role as a catchment manager will use the framework document as a basis for encouraging improved management of vegetation. It will actively promote the framework's implementation with all stakeholders and will itself undertake many of the actions listed. It will coordinate a number of the aims, especially those relating to the collation and maintenance of up-to-date information, will promote vegetation surveys and research programs and the development of monitoring programs. It will seek to work in partnership with other stakeholders, will facilitate cooperative effort through workshops, seminars and discussion groups, and publish and distribute widely relevant resource information and guidelines for improved management practices. The Trust has a role also in assessing revegetation, other remediation and educational projects that seek funding from a variety of sources. The framework provides the Trust and the community with the type of proposal that it will support in funding applications. The Trust's catchment management committees, with local knowledge and expertise, have a central role to play in assisting community groups with planning and implementation of on-the-ground projects.

Implementation and feedback

The Trust coordinated the development of the framework through consultation and community participation to provide a consistent base for planning and action across the catchment. The Trust invites everyone to use the framework, to implement the policies and actions within it, and where necessary to develop more detailed plans and actions relevant to specific areas within the overall context of the framework.

The Trust will be seeking feedback on the usefulness of the framework and associated resource and guideline documents being produced. These documents are not 'set in concrete' but rather ones that can be continuously added to, and reviewed and revised in the light of comments and experience. The framework document is considered to be just a small, but basic, contribution in a long-term process that will attempt to meet the catchment community's goal for vegetation.

--ooOoo--

AN ENHANCED WEED MANAGEMENT PROGRAM FOR NSW NATIONAL PARKS

Andrew Leys, Coordinator Pest Management
NSW National Parks and Wildlife Service

Introduction

New South Wales has an extensive system of conservation areas such as national parks, nature reserves and wilderness areas with a total area of approximately 4 million ha. Under the National Parks and Wildlife Act the National Parks and Wildlife Service has a statutory responsibility for the management of these areas and for the protection and care of nature, and Aboriginal and historic heritage throughout New South Wales.

The goal of the Service's weed control programs is to manage populations:

* to reduce their impact on native flora and fauna, and
* to minimise their spread onto neighbouring properties.

Humphries et al (1991) have defined environmental weeds as those that cause major modification to species richness, abundance or ecosystem function. Other definitions include species which have, or have potential to have, a detrimental effect on economic, social or conservation values of an area.

At a recent workshop to develop the NSW Weeds Strategy there was considerable debate on whether environmental weeds should be considered as a separate entity, or whether they should be treated the same as other weeds. I could agree with the latter argument, if environmental weeds were being treated the same as other weeds. Unfortunately they are not. The emphasis on declaration, and hence enforced action for the community's good under the Noxious Weeds Act, is on agricultural weeds. The Strategy needs to ensure that there is adequate research on environmental weeds, and that additional funds need to be made available to implement effective control programs.

New directions

Weed management on Service estate received a major boost last year with the announcement that funding for pest management (animal pests and weeds) will increase to a level of $5 million per year by 1997/98. The funds will be used to appoint District staff with specific responsibilities for pest management. Funds provided under the package will also be used to provide resources for District weed control programs.

Already 28 staff have been appointed to the districts, while my position has been created in Head Office to coordinate the development and implementation of the district programs. During 1994/95 the Service has undertaken 146 weed control programs. This obviously involves a wide range of species including well known noxious weeds of agricultural areas, such as serrated tussock *(Nassella trichotoma)*, and blackberry (*Rubus fruticosus*), as well as species specific to conservation areas such as bitou bush (*Chrysanthemoides monilifera*), privet (*Ligustrum* spp.), Madeira vine (*Anredera cordifolia*) and bridal creeper (*Myrsiphyllum asparagoides*). Emerging weed problems such as Mysore thorn (*Caesalpinia decapetala*), willows (*Salix* spp.), Easter cassia (*Senna pendula*) and glory lily (*Gloriosa superba*), also have to be addressed.

One of the major problems in planning weed management programs for environmental weeds is that there are no recognised criteria to assess their environmental impacts: existing information is mainly descriptive. However, the Service is in the process of developing a process which will allow weed problems to be objectively assessed. In this way we will be able to make more efficient use of the resources available.

Key programs are discussed in the following section.

Bitou bush

A cooperative program involving landholders, local community groups, NSW Agriculture and universities, is being undertaken to ensure an integrated approach to controlling bitou bush is adopted on Service lands. This includes release of biological control agents, when available, herbicides (by Service staff, contractors and volunteers) and removal by hand where that is possible.

The Service also allocates approximately $50,000 per year towards the national program on biological control of bitou bush. This program is coordinated by Standing Committee on Conservation's Task Force on Weeds of Conservation Areas. It includes research being undertaken overseas and in Australia by CSIRO Division of Entomology, the Victorian Department of Conservation and Natural Resources and NSW Agriculture.

The bitou tip moth *(Comostolopsis germana)* has now been released at over 50 sites in New South Wales, many of these on Service land. (eg Yuraygir NP, Sea Acres NR, Booti Booti NP, Wyrrabalong NP and Botany Bay NP). Two new agents the bitou tortoise beetle *(Cassida sp.)* and the bitou seed fly *(Mesoclanis polana)* are planned for release later this year and most of the releases will be on Service land (eg Yuraygir NP, Myall Lakes NP and Botany Bay NP). In all cases Service staff are working closely with NSW Agriculture to select the most appropriate sites and to assist with monitoring establishment of the agent and its impact on bitou bush.

Although bitou bush is only declared a noxious weed in 4 local government areas outside the Sydney Metropolitan Area Service staff have developed, or are developing, management plans to control it on most of our parks and nature reserves. This usually involves the use of glyphosate applied as a cut-stump treatment (scattered plants in amongst native species), or as a foliar spray where monocultures prevail. The area infested with bitou bush has been reduced substantially in some parks and reserves (eg Broulee Island Nature Reserve) although in most cases the infestations are so widespread that a containment program combined with a progressive reduction plan is the only feasible management strategy (eg Yuraygir NP).

The NPWS is also working closely with NSW Agriculture research scientists to evaluate the effectiveness of aerial applications of low rates of glyphosate (2 L/ha of product). Preliminary research by these scientists shows that when applied at these rates during winter, glyphosate is very effective on bitou bush and is well tolerated by native species (so far over 80 species of native plants have shown tolerance to glyphosate). Staff are also closely involved with research being undertaken by the School of Biological Sciences at the University of Wollongong (Professor Rob Whelan) which is monitoring the impact of this control technique on native flora and fauna.

In addition Service staff are attempting to foster volunteer bush regeneration groups for most areas where bitou bush is a problem.

Groundsel bush

Groundsel bush (*Baccharis halimifolia*) is an important weed in many coastal areas of New South Wales, especially the North Coast. It thrives in saline, semi-tidal conditions to readily colonise coastal swamps and forests which have been disturbed by fires, floods or human activities. Until recently groundsel bush infested large areas the Yuraygir and Bundjalung National Parks and nearby nature reserves, where it competes with native plants, often replacing them completely. Jeff Thomas, NPWS Pest Management Officer at Grafton, has coordinated the groundsel bush control program in the Grafton area. Over 1,100 ha of groundsel bush has now been treated, and many of the areas are now free of the weed. A more detailed paper on this program has been written by Jeff, and appears elsewhere in these proceedings.

Scotch broom

Scotch broom (*Cytisus scoparius*) is very competitive with native species and can exclude many understory species. The seed has considerable dormancy and can survive in the soil for many years to germinate given favourable conditions.

Scotch broom is a serious threat to the integrity of plant communities in a number of conserved areas. The largest infestation occurs in the Barrington Tops area, although other major infestations occur in the Central and Southern Tablelands with scattered infestations in Kosciusko National Park.

The Service is currently developing management plans for each of its parks in which Scotch broom occurs. This will involve the use of herbicides and biological control agents, and in some instances, physical removal.

The Service has continued to contribute to the cooperative program for biological control of Scotch broom. The program is also supported by NSW Agriculture, CSIRO, State Forests of NSW and the Hunter Pastoral Company. Recently a major grant has been provided by the NSW Environmental Trusts.

Already two agents, the broom twig mining moth and the broom psyllid, have been released. Scientists plan to release another agent, *Bruchidius villosus*, later this year.

Serrated tussock

The NPWS is cooperating with NSW Agriculture, local government councils, Landcare groups, catchment management committees and agribusiness in a major campaign on serrated tussock (*Nassella trichotoma*). The aim of this campaign is to develop a strategic approach to the control of this weed. The Service also contributed towards an international survey for potential biological control agents for serrated tussock which has recently been undertaken in Argentina.

Bushland regeneration programs

The NPWS is also working closely with volunteers to help regenerate bushland in many of our national parks. Some of the most active programs are in the Sydney Metropolitan area. Volunteers regularly work with the Service helping to remove many weeds including bitou bush, lantana (*Lantana camara*), privet (*Ligustrum* spp.) balloon vine (*Cardiospermum grandiflorum*) and wandering jew (*Tradescantia* spp.).

The North Metropolitan District has a very active bush regeneration team headed by Coordinators, Lynn Rees and Richard Colbourne. Lynn and Richard have established more than 35 groups with a total of more than 300 volunteers in the Lane Cove, Garrigal and Kuringai Chase National Parks. Such volunteer programs contribute enormously to the Service's weed control effort. The Coordinators have estimated that the value of the labour for a recent 12 month period is worth more than $240,000. An excellent newsletter (*Regenavitis*) has been produced, as well as several weed technical sheets: regular training workshops are held for the volunteers. The team has been successful in obtaining a major grant from the Urban Rivers Reborn Program to help support this work.

The Sydney and South Metropolitan Districts have smaller, but similarly effective volunteer programs operating in the Sydney Harbour, Botany Bay and Royal National Parks. Successful volunteer programs also exist in many other parks.

Rainforest weeds

Seventy five percent of the rainforest present in Australia at the time of European settlement has now been cleared. Much of what remains is fragmented and subjected to disturbance by fire, desiccation and increased light penetration (Humphries *et al.* 1991) The Service will be undertaking rehabilitation works in rainforest remnants occurring within 13 Nature Reserves in the Lismore District (Joseph 1995).

The philosophy adopted in this program is that effective rehabilitation of native plant communities requires an integrated approach based on a thorough understanding of the rainforest ecosystem. While weed control is a vital component of such a program, the aim is to replace all weeds with native species in such a way that the process of natural regeneration and succession is sustainable. This contrasts with the more traditional approach of selectively targeting control programs towards individual species.

In the Boatharbour Nature Reserve 23 weed species were identified with the most common species being Madeira vine (*Anredera cordifolia*) and wandering Jew (*Tradescantia albiflora*). The presence of Madeira vine poses the most serious threat to this reserve and it will require a long-term weed control program to reduce the area infested and then to maintain it at manageable levels. The eastern portion of this Reserve is particularly degraded and is the major source of spread because of its upstream position. Wandering Jew poses a further threat because of its density which restricts the germination and establishment of native species. Most of the remaining weed species are more limited in their distribution and abundance. However, they have the potential to increase unless appropriate management strategies are adopted (Joseph 1995).

In the Brunswick Heads Nature Reserve 56 weed species were identified and their importance varied with habitat. Important species include bitou bush (*Chrysanthemoides*

monilifera), lantana (*Lantana camara*), Cape ivy (*Delairea odorata*), coral berry (*Rivina humilis*), climbing asparagus (*Protasparagus plumosus*), ground asparagus (*Protasparagus aethiopicus*), Madeira vine (*Anredera cordifolia*), glory lily, coastal morning glory (*Ipomoea cairica*), camphor laurel (*Cinnamomum camphora*), common morning glory (*Ipomoea indica*) and fishbone fern (*Nephrolepsis cordifolia*).

Mapping weed distributions

The Service is developing a database to record and map the distribution of important weed species. Apart from the rainforest remnants project discussed previously, other mapping programs underway include groundsel bush in the Yuraygir and Bundjalung National Parks and Scotch broom in the Kosciusko National Park. Staff will also be combining with NSW Agriculture and local government councils to re-survey the distribution of bitou bush throughout New South Wales.

Conclusion

The NSW National Parks and Wildlife Service is substantially increasing the human and financial resources it allocates to weed management. The Service is keen to collaborate with local government councils and other public authorities to ensure weed control programs are better planned and implemented.

Acknowledgments

Several colleagues contributed towards this paper and I acknowledge the help of Rosemary Joseph, Samantha Olson, Jeff Thomas, Lyn Rees, Mike Dodkin and Rus Knutson.

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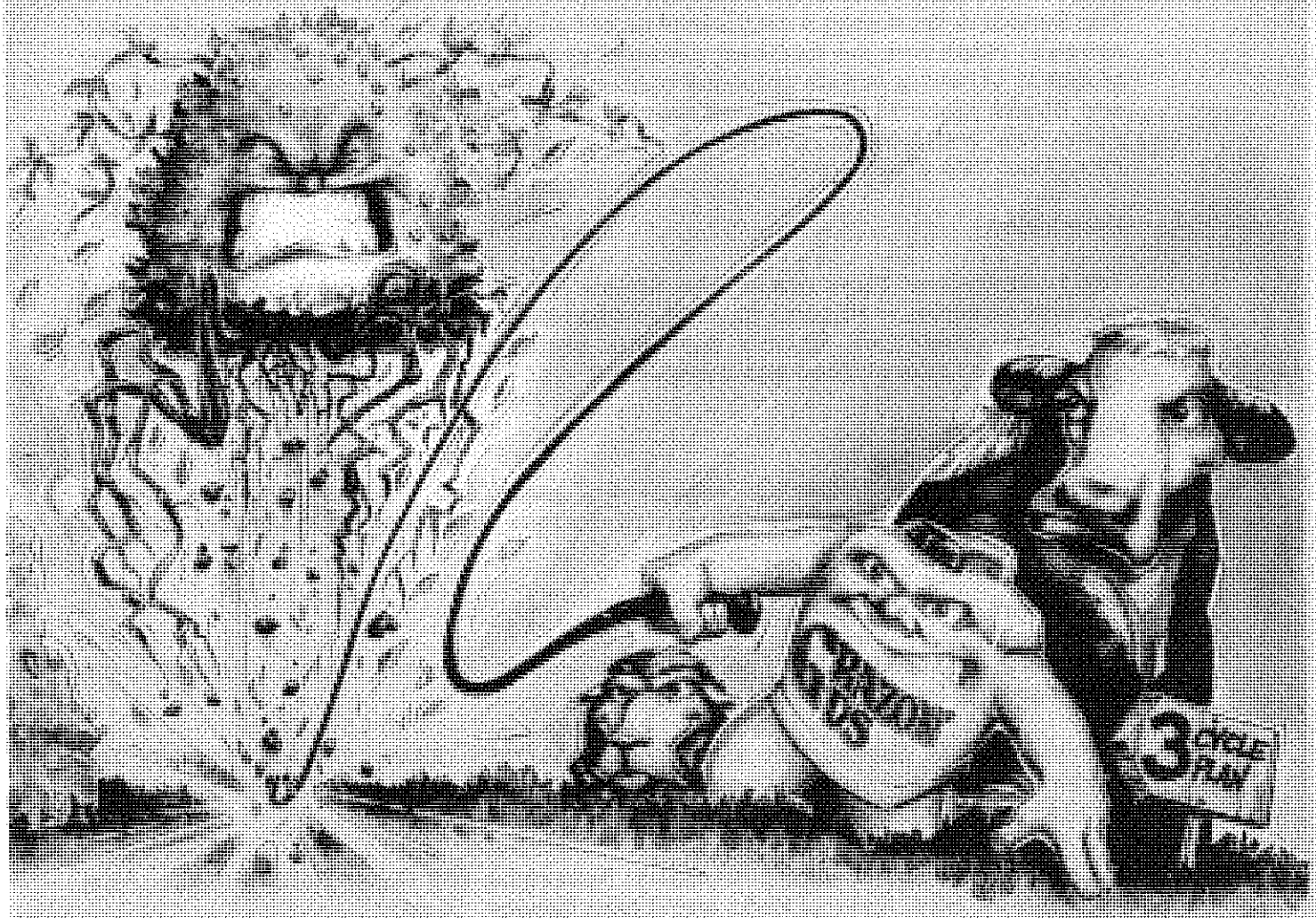

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LICENCES FOR HERBICIDE USE IN OR NEAR WATERS

Jane Mallen-Cooper
Waters & Catchments Branch
NSW Environment Protection Authority

INTRODUCTION

Public and private landholders are legally obliged to control noxious weeds under the *Noxious Weeds Act 1993.* The use of herbicides to control noxious and other weeds is central to most weed control programs. Ideally, it forms part of an integrated suite of techniques carried out on a catchment basis (the principle being that if you have put a lot of resources into weed control in a certain area, it is undesirable to have your treated areas reinfested from elsewhere in the catchment).

People involved in weed control activities need to be aware of certain legislation administered by the EPA, particularly the Clean Waters Act 1970 which contains provisions to prevent or minimise water pollution. In addition, the EPA will soon be responsible for administering the Pesticides Act. However, because the transfer of the Pesticides Act from NSW Agriculture to the EPA is not yet completed, I am going to focus on water pollution control today.

At the end of the talk, I hope you will:

* have some understanding of the relevance of the EPA legislation, particularly the Clean Waters Act;

* know whether an EPA licence is needed for the spraying of herbicides to control noxious or other weeds; and

* understand how the EPA is addressing your key concerns in relation to the draft Licensing Guidelines for Herbicide Use In or Near Waters.

EPA LEGISLATION

So how are your weed control activities affected by the EPA legislation?

The Act which has significant implications for the weed control industry is the *Clean Waters Act 1970* and its associated Regulations (*Clean Waters Regulations 1972*).

Section 16 (1) of the Clean Waters Act states that "a person shall not pollute any waters"! In this context, waters encompass anything from pristine lakes, rivers and wetlands to drains. Pollute is defined as "to place in or on, or otherwise introduce into or on to, the waters...any matter...so that the physical, chemical or biological condition of the waters is changed..., and you are deemed to pollute if you "place any matter...in a position where...it falls, descends, is washed, is blown or percolates [or is likely to do so] into any waters..."

Thus the direct application of herbicides to waters, or to adjacent lands where they might "fall, descend, wash, blow or percolate" into waters, is pollution as defined by the Act.

And as a note of caution, pollution as defined by the Act could also apply to the sedimentation of water courses as a result of mechanical removal - so it is important not to expose large areas of bare soil during weed control activities. Soil conservation measures may be needed to prevent large volumes of soil from washing into drainage lines.

Penalties for polluting waters can be substantial, and are set out in the *Environmental Offences and Penalties Act 1989*. The maximum penalties are $1 million for corporations and $250,000 and/or 7 years imprisonment for individuals, where wilfulness or negligence is evident and significant harm has been occasioned to the environment. More commonly, penalties range from $600 for a minor infringement to $50,000-$100,000 where serious environmental harm has been occasioned, but wilfulness is not involved.

LICENSING

In the last few years, (probably particularly since the introduction of the Environmental Offences and Penalties Act), there has been increasing interest in the whole area of EPA licensing in relation to herbicide application activities.

In particular, local government councils, council employees and other weed control operators have become concerned that they could incur severe penalties under the *Environmental Offences and Penalties Act 1989* should they pollute waters as a result of herbicide use.

Some local authorities have also become concerned that third parties may seek court orders under Section 25 of the Environmental Offences and Penalties Act to restrain activities such as herbicide application which could be seen as potentially harming the environment. Such actions could significantly interfere with weed control operations, and thus these local authorities have sought the "protection" of a pollution control licence.

So, should all herbicide application activities be licensed?

The short answer is no.

In the majority of cases (for example, the spraying of weeds along road verges, in farm paddocks or in parks and reserves where the weeds are not immediately adjacent to water), the EPA considers that a licence is unnecessary because the pollution of waters can be prevented by carrying out weed control programs in an environmentally responsible way - this is often referred to as the "due diligence" approach.

i.e. it is the responsibility of everyone involved in weed spraying operations to exercise due diligence and thereby prevent pollution of waters.

Exercising "due diligence" involves the implementation of widely-understood and practical techniques such as:

* only using herbicides which the container label states are registered for the particular weed species and location in question (e.g. diquat is registered for the control of *Salvinia* in waterways);

* applying herbicides strictly in accordance with directions on the registered label;

* applying herbicides in accordance with "best management practices" as specified in the national *Guidelines for the Use of Herbicides In or Near Water* (1985) or any other EPA-recognised guidelines or codes of practice;

* ensuring herbicide users are fully trained in the proper use of herbicides (e.g. the Farm Chemical Users Training Program);

* ensuring that any observed impacts resulting from the use of herbicides are reported immediately to the EPA and dealt with quickly to minimise environmental harm; and

* where practicable, co-ordinating weed control activities within catchments.

However, in some circumstances (for example the spraying of aquatic weeds) the pollution of waters is unavoidable. Even if you follow all best management practices, you are going to pollute waters as defined in the Clean Waters Act.

In these cases, the EPA would recommend obtaining a licence. The licence will contain conditions which aim to minimise harm to the environment.

Providing all licence conditions are followed, a licence is a protection against prosecution. Section 16 (6) of the Clean Waters Act states that "it shall not be an offence arising under those provisions for a person to pollute any waters if he holds a licence and does not pollute the waters in contravention of any of the conditions of the licence".

To be granted a licence, a weed control operator would need to provide information regarding:

* weed control planning - proposed spray locations, proposed times of spraying, types of herbicides to be used, target species, proposed method of application, likely environmental impacts, monitoring provisions; and

* justification of the use of the herbicide. This is necessary to demonstrate that this is the best available control option, and will have the least overall environmental impact.

You supply this information with a form available from all EPA regional offices.

If the EPA accepts the application, the individual or agency is granted a licence under the *Pollution Control Act 1970*. This Act sets out the mechanisms and details for granting and administering licences and the rights of appeal in relation to licences. The EPA would grant a licence providing it was satisfied that the need to spray was essential and gave the best outcome, that best practice would be followed and that registration and provisions of the Pesticides Act would be complied with.

Licences have conditions attached to them. These need to be followed in all weed control operations. For example, a licence might specify the type of monitoring that would be required, or the procedures to follow in the event of a pollution incident.

LICENSING GUIDELINES

The EPA position on licensing is set out in the draft Licensing Guidelines for Herbicide Use In or Near Waters. This document was sent in mid-January 1995 to a wide range of stakeholders (e.g. all local councils, weeds county councils, Rural Lands Protection Boards, relevant government agencies, peak industry and conservation groups). About 50 submissions were received between January and July, and I'd like to take this opportunity to thank everyone here who made a contribution.

While most people were supportive of the draft guidelines in principle, many complex issues were raised over a broad range of subjects, and many (often conflicting) points of view were expressed.

What I thought might be useful is for me to list the most commonly raised issues from the submissions, and then discuss our current thinking about these issues.

1. Perceived conflict between the Noxious Weeds Act, aspects of pesticide registration and the Clean Waters Act

The Noxious Weeds Act makes it a legal responsibility to control noxious weeds on both public and private land. The Clean Waters Act ensures that you control the weeds in a manner that prevents or minimises the pollution of waters. These are complementary roles, given that the Clean Waters Act does not prohibit appropriate herbicide use.

Registration, previously under the Pesticides Act and now predominantly under the Commonwealth legislation (Agvet Code 1994), takes into account the effects of a particular chemical on human health and the environment. However, registration alone could never guarantee total chemical safety in the environment. For example, the registration process cannot really address cumulative impacts (e.g. using a number of different chemicals in the same catchment or subcatchment and impacts which arise from continued and extensive use of a herbicide) or the relationship between herbicide use and catchment condition (e.g. in relation to soil loss and runoff, availability of buffer strips, depth of the groundwater) - these all need to be looked at on a case by case basis for the best environmental result. Similarly, the sensitivity of the receiving environment needs to be considered (e.g. rare species), and it must be remembered that much of the ecotoxicological data is based on a limited range of species under laboratory conditions.

2. Concern that the EPA is taking a litigation approach rather than a more 'educational/best management practice' approach

The EPA recognises that educational aspects are very important. This incorporates the provision of appropriate training, advice and information through to the development of best management practices and sustainable systems.

The licensing option and the legal implications of polluting waters have remained unchanged for 25 years, since the Clean Waters Act was introduced. Licences are not obligatory. Where a person, however, chooses to seek a licence, the EPA has a duty to determine the application.

Your decision to apply for a licence or not to apply for a licence is really a matter of risk assessment. If your activity is unlikely to pollute waters, you probably don't need to apply for a licence. If your activity is likely to significantly pollute waters, it can only be carried out legally if it is licensed by the EPA (in this case the EPA would need to consider that the gain from the activity outweighed any environmental harm).

3. Concern over cost of licences

An annual licence for herbicide spraying generally costs 2 fee units = $146.60. The EPA also issues short-term licences for one-off programs, which cost a proportion of the annual fee depending on the number of months required (minimum $73.30 to cover administration costs).

4. Need for up to date best management practice information

There is no doubt that people want, and would use, best management practice information. In the draft licensing guidelines, we refer to the 1985 national Guidelines on Herbicide Use In or Near Water (now 10 years old).

You will be pleased to know that a review of the 1985 Guidelines for Herbicide Use In or Near Waters has been recommended by the Water Resources Management Committee, a subcommittee of the Standing Committee on Agriculture and Resource Management.

Until this updated information becomes available, make good use of the information currently available to you. Information is available from training courses, NPAOs and other staff from NSW Agriculture, and relevant experts from other organisations. You collectively are also the source of considerable expertise, so discussions with other weed operators and managers facing similar problems are very valuable.

5. When do you need a licence *near* waters (rather than in waters)?

This is a question which was of interest to many respondents. This is something that really has to be evaluated on a case by case basis, as is will vary according to the type of vegetation adjacent to waters, the toxicity and persistence of individual chemicals, the amount of chemicals being used, the manner in which they are being applied etc - it is an assessment of the risk of polluting waters and causing environmental harm.

6. Does EPA have the expertise and authority to make a decision on whether herbicide application is the most appropriate option?

The EPA does have expertise in this area, and this will be enhanced by the transfer of officers from NSW Agriculture to administer the Pesticides Act. The EPA does not make these decisions without seeking advice, when appropriate, from a wide variety of sources.

7. Need greater use of non-chemical methods and better consideration of alternatives to herbicide use

There is considerable impetus for herbicide use - herbicides are often quick, effective, relatively cheap, and have been used for a long time. People don't necessarily like them, but they are seen to do the job. Alternatives to herbicide use are often dismissed as too

expensive, and in some cases the outcomes are seen as too uncertain. A contributing factor to the differential costing of weed control practices is that environmental resources are frequently undervalued in economic analyses.

I think that it is true to say that fully integrated weed management still has a long way to go, but it is certainly worth aiming for. An important contribution can be made by monitoring herbicide and other application techniques for their effectiveness and impacts.

8. What information do you need to provide with a licence application?

This was discussed above. Briefly reiterating, you need to provide information on where, what, how and why! The key to a successful application is the quality of the planning and management advice provided.

9. Who holds the licence? (Contractors, individual landholders, councils, other government authorities etc)

The person who applies for and is granted the licence is the licence holder. This usually is the person or agency which is seeking the protection of the licence.

10. Site specific versus regional licences

There is some scope for regional licences, applicable for example to a river or several rivers, providing site specific conditions are not required or can be determined at the time of application. A regional licence requires good planning on the part of the applicant - the EPA would need to have a copy of the regional program, and then the licensee would notify the nearest EPA regional office prior to working in a particular area.

11. Difficulties in specifying timing of weed control operations

While it may not be possible to specify actual dates of spraying, because of the possibility of unsuitable weather conditions and other unforeseen factors, it is certainly possible to specify a preferred time of spraying (e.g. the first week of September or the nearest suitable date), and then to notify the EPA one or more days before the event.

12. What sort of monitoring is required?

There is no single monitoring program which is appropriate for all herbicide applications. The monitoring program will vary according to the scale of the weed control program, the types of chemicals being used, the uses of the water (drinking water, stock water, irrigation water etc), the likely environmental impacts etc. Monitoring programs are determined by the relevant EPA region, with an appreciation of local conditions.

As a broad rule of thumb, the larger the program and the greater the potential impact, the more intensive the monitoring. Thus for example, small control operations involving spot spraying of weeds in a water course and at the water's edge may require a visual inspection of the treated areas (looking for any adverse impacts on aquatic biota other than the target species, and to determine the effectiveness of the spraying). This may need to be done at 2 or 3 time intervals (e.g. after 1 day, 1 week and 1 month), and perhaps consider impacts within 2 kilometres downstream of the treated sites. A major

program, such as spraying dense water hyacinth along 30 kilometres of river, may require more intensive monitoring e.g. in addition to the visual inspection, the EPA may require sampling of dissolved oxygen levels and some samples of water, sediments and/or biota for herbicide residues.

13. Delays in issuing the licence

Several submissions listed the time taken for the EPA to process licence applications as a significant concern.

You can contribute to the efficient issuing of licences by (i) having in place a well-planned and well-documented weed program, so that "non-emergency" control programs can be planned in advance, and so that information required by the EPA is readily obtainable and of an appropriate quality; (ii) providing the right information with the application (as discussed above, and this will be included in the revised guidelines); and (iii) maintain regular contact with the relevant EPA regional officer on the progress of the licence.

In a genuine "emergency" situation, the EPA can issue a licence quickly so that control programs can be implemented.

14. What constitutes appropriate training?

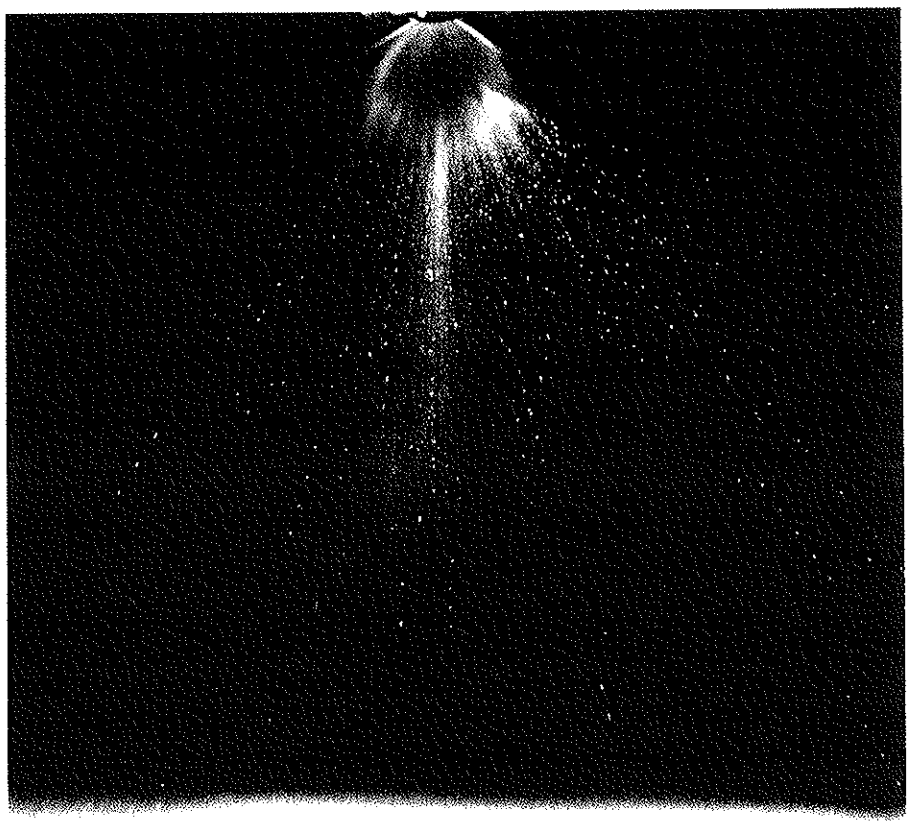
Farm Chemical User Training Program or equivalent (the EPA would seek advice from NSW Agriculture).

We are now finalising the guidelines in the light of comments received, and aim to release them shortly.

The control of weeds is a very important task, with significant benefits for production systems, amenity and the environment. It is in all of our interests to carry out this task in a manner which enhances productive land uses and amenity, while protecting the natural resources on which they are based. We need to work together to achieve the best outcomes - less weeds and a healthy environment!

--ooOoo--

How to Increase Effectiveness of Pesticides with Spray Adjuvants.



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REVIEW OF THE NOXIOUS WEEDS ACT, 1993

Peter Gray
Noxious Plants Advisory Officer
NSW Agriculture, Dubbo

Two years have elapsed since the enactment of the Noxious Weeds Act 1993. This Act replaced the noxious plant control provisions of the Local Government Act 1919.

The 8th Biennial Noxious Weeds Conference was an opportune time to give councils an opportunity to comment on the Act and, in particular, any aspects which they believed needed amending. As with any new Act it is only after the legislation has been in operation for some time that it can really be evaluated.

Prior to the conference councils were invited to submit written submissions to form the basis for the session. Twenty two replies were received raising points of concern.

Two legal officers of NSW Agriculture Ms Sally Pearmain and Barbara Jones conducted the session and in addition to leading the discussion also advised many of the speakers on how to handle concerns they raised.

The points raised in the submissions and those raised during the discussion will be considered during the forth-coming review of the Act.

The major concerns raised were:

- The requirement to give notice before entering a property.
- The procedures for giving notice to enter.
- Appeal to the Land and Environment Court, particularly in regard to W1 noxious weed.
- The term `land' should also indicate `water'.
- `Twenty four hours notice' should be `at least twenty four hours notice'.
- `Knowingly scatter' should be `scatter'.
- Sale etc. of W2/W3 noxious weed material.

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GGAWM0995

ADJUVANTS - NEW DEVELOPMENTS - FUTURE TRENDS

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Adjuvant History

Crop production use of adjuvants dates back over 100 years when kerosene and soap was used as in insecticide.

Adjuvants were used in early `30s with organic herbicides. Their use grew slowly until the `50s when surfactants came into prominence as adjuvants, ie. Benefits gained when used with 2, 4-D. I remember using "Plus 50", "Swish" and "Raintain" in the 60's and being involved with "Foamspray", an antidrift material early in the 70's.

The development of adjuvants has continued both in general agriculture as well as I.W.C. work. Today their use is widely involved in agrichemical manufacture and also in agriculture - so much for history.

I suggest that each of you have used additives/adjuvants at some time in the past, ie:-

- Roundup® (Glyphosate) + Ammonium Sulphate (Liaise).
- Brush Off ® + nonionic wetter/surfactant.
- Kerosene, ad additive, to reduce foam in tanks.
- Probably P.S.O. and/or vegetable oils for drift control, rainfastness and other qualities.

Brief Technical Overviews

Adjuvant chemistry is not a topic we can cover in a short presentation and I don't intend to try to cover in depth, rather, I'll try and clarify some of the terminology used, ie. Wetting Agents, Surfactants, Penetrants, emulsifying, buffering agents.

The following definitions are approved by the Statuary body, A.A.V.C.C, which approves chemicals prior to use within a State.

Glossary

ADJUVANT	a substance added to farm chemical to improve its effectiveness or safety, eg. Penetrants, spreader-stickers, wetting agents and surfactant oils.
BUFFERS	adjuvants used to retard chemical degradation of some pesticides by lowering the pH of alkaline water.
DISPERSING AGENT	an adjuvant that facilitates mixing and suspension of a pesticide formulation in water.

DRIFT RETARDANT an adjuvant added to a spray mixture to reduce drift.

EMULSIFYING AGENT/EMULSIFIER	a chemical which aids in the suspension of one liquid in another which normally would not mix together; forms an EMULSION ie. oil and water.
ENCAPSULATED PESTICIDE	a pesticide formulation with the active constituent enclosed in capsules of polyvinyl or other synthetic materials, ie. slow release chemical or fertiliser or the encapsulation of a pesticide via the use of a vegetable oil ie. Codacide.
FOAM RETARDANT	an adjuvant used to reduce the foaming of a spray mixture due to agitation.
PENETRANT	an adjuvant added to a spray mixture to enhance the absorption of a product.
SPREADER	an adjuvant used to enhance the spread of a chemical over a treated surface, thus improving the coverage.
STICKER	an adjuvant used to improve the adherence of spray droplets to a plant, animal, or other treated surface.
SURFACTANT	the word is derived from the phrase SURface ACTive agENT. An inert ingredient which improves the spreading, dispersing, and/or wetting properties of a farm chemical mixture.
WETTING AGENT	an adjuvant used to reduce the surface tension between a liquid and the contact surface for more thorough coverage.

Adjuvants can be described in general by what they are intended to do in a herbicide mix. The diagram below illustrates these groups.

ADJUVANTS

SPRAY MODIFIERS	**ACTIVATORS**	UTILITY MODIFIERS
* Stickers	* **Surfactants**	* Emulsifiers
* Film Formulas	* **Wetting Agents**	* Anti Foam
* Spreaders	* **Penetrants**	* Buffers
* Deposition Agents	* **P.S.O (PSO)**	* Compatibility Agents
* Thickening Agents	* **Vegetable Oil**	* Anti Foam Agent used with herb & fertiliser
* Deposition Agents	This group is most important for foliar applied * Herbicides * Improve biological activity	

In general, your work involves post emergence, folia, applied herbicides and therefore, the important group is ACTIVATOR ADJUVANTS. This group can also help with residual applications.

A point of interest is that while SURFACTANTS make up a very large class of adjuvants.

NOT ALL ADJUVANTS ARE SURFACTANTS

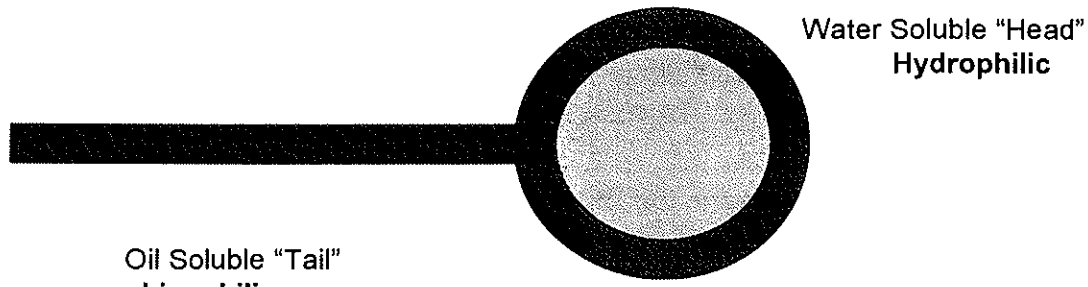
Surfactants

Surfactant Molecules

Regardless of their chemical properties, surfactants have a common feature, they comprise two (2) segments.

- A strong polar group which is attracted to water (referred to as HYDROPHILIC)
- A non-polar group attached to oil materials (referred to as LIPOPHILIC)

Diagram



Depending on the IONIC (static electrical) charge of the water head determines the surfactant classification.

-	ANIONIC	-	Negative
-	CATIONIC	-	Positive
-	NON-IONIC	-	Neutral

The length of the "tail" on the other hand determines the oil attachability.

The "heads" affinity for water determines the surfactants emulsifying qualities.

Herbicides, I believe, are still your major tool.

It is a recognised fact that between 1-3% of chemicals applied in a water carrier are biologically effective, ie. Kill Weeds (Graham; Bryce; Caseley; Himel, et al)

The high chemical (Herbicide) wastage arises from using water as the spray carrier. Losses result from:

- Evaporation
- Droplet Drift
- Poor uptake and failure to stick to target
- Run off

I believe this is wasteful, uneconomical and harmful to the environment.

Can adjuvants improve Herbicide effectiveness and their performance?

The answer is YES, however, there must be a marriage between the product (Herbicide) and adjuvant used.

Research in the last decade has led to a rapid increase in the use of ADJUVANTS that improve the performance of sprays in a water carrier, ie. wetters, spreaders, stickers, penetrants, etc.

I wish to elaborate today, about Codacide®, a vegetable, spray oil.

Codacide History

Briefly, it was developed in the UK in 1983 when Mr Barnett, working on Control Droplet Application (CDA) equipment, used vegetable oils to obtain uniform droplets, minimise drift and obtain chemical plant adhesion.

Incidentally, the name "Codacide" was derived from the C of D.A. (cide), hence the name.

What is Codacile Oil?

Codacide is 95% NATURAL CANOLA (food grade) oil with 5% of special compound EMULSIFIERS which are the key to its consistent performance. When premixed with the chemical(s), the emulsifiers latch onto the chemical molecules ENCAPSULATING them in a coating of oil. It is this encapsulation that is the key to Codacide's efficiency as a CARRIER of chemicals.

Results of Encapsulation are:-

- Reduction in number of small droplets
  - uniformity of droplet size
  - control drift
  - increased plant contact under wind, temperature, low humidity
- Is non phytotoxic and biodegradable
- Increased adherence - (Sticker)
- Spreadability - 8-16 times more than water
- Less evaporation - (longer chemical contact)
- Rainfastness

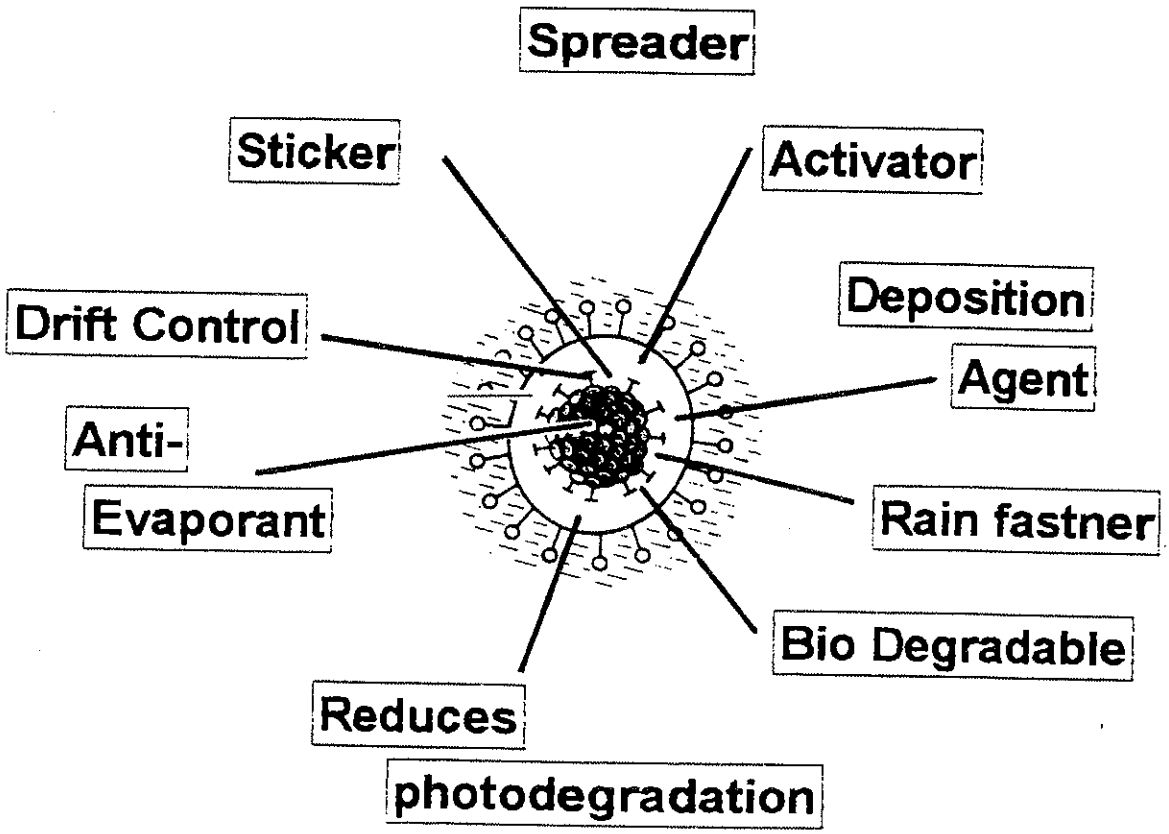
- Increased uptake - Triglycerides oils of plants are the same as in Canola oil. (There is a mutual affinity between the two).
- UV protection - reduces photodecomposition
- Shields the chemical from volatility loss

Codacide is fully biodegradable into CO^2 and H^2O (Carbon Dioxide and Water). It does not change the active ingredient (pesticide) in any way, nor impede the normal degradation of the pesticide.

Codacide, therefore, is a multi purpose adjuvant.

CODACIDE®

Multi-purpose Vegetable Oil Adjuvant Carrier



FUTURE TRENDS

- Continuing pressure, world wide, to reduce pesticide use in agriculture, horticulture and Linear Reserve Management areas.

- Council/Shire/Community concerns will influence need for environmentally friendly products:
  - Biological products
  - Native competitive species
  - Alternate Management Practices (IPM)

- Continuing research on how current/future adjuvants will influence droplet deposition, retention and drift control will benefit application technology.

- Adjuvants for Agrochemical - why we need to know precisely how they work - mode of action, enhancement of biological activity.

- Pesticide spray carriers of the future may not be water.

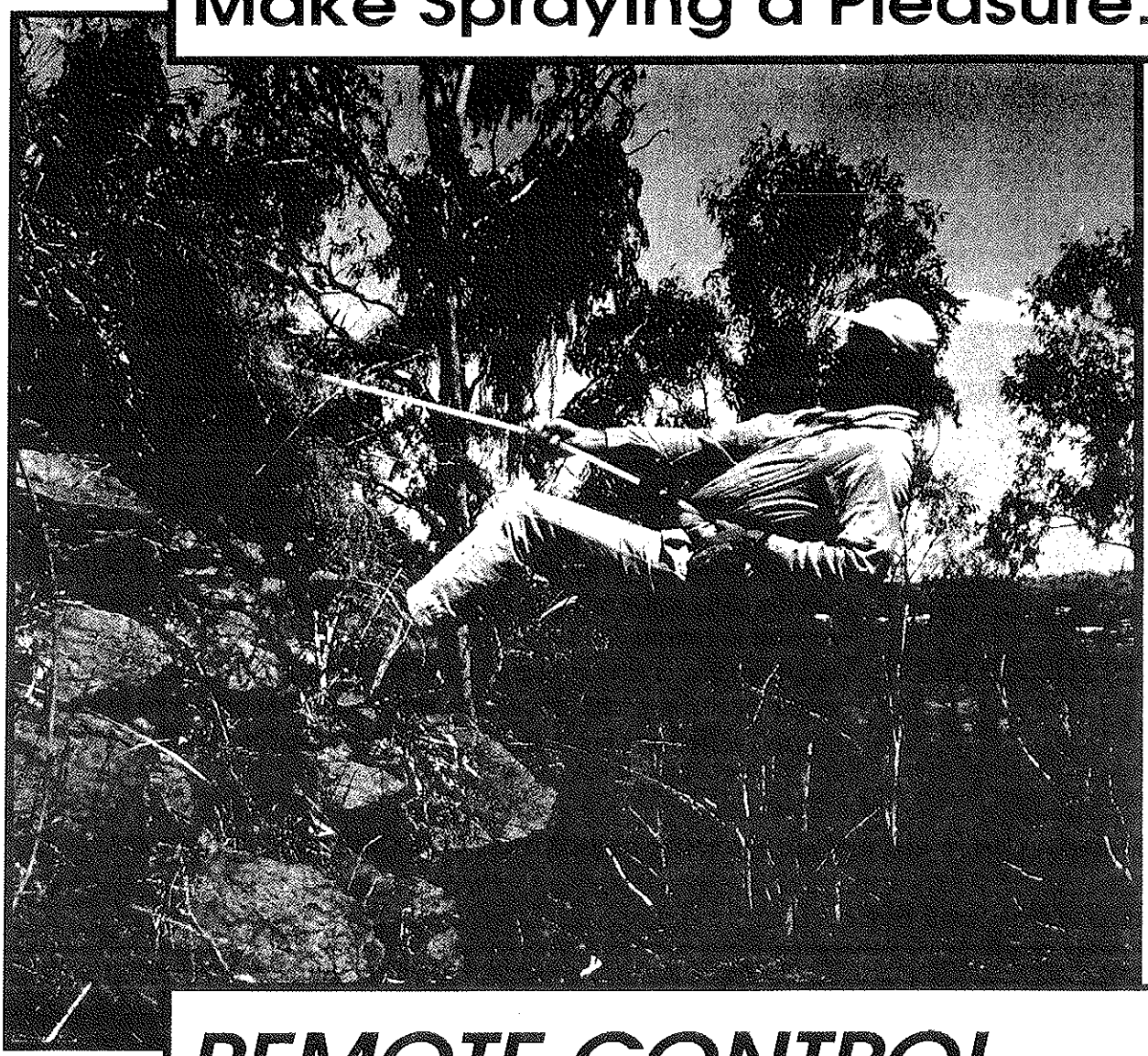
> Wars will be fought over water,
>
> World Bank warns
>
> Aust. 8/8/95

- Genetic engineering may change current noxious plants to useful ones. (Ref: Recent Research; St John Wort can provide a useful natural medicine oil from the harvested flowers).

--ooOoo--

QUIK SPRAY

Make Spraying a Pleasure.



REMOTE CONTROL RETRACTABLE HOSE REELS

QUIK SPRAY

Remote Control *RETRACTABLE* Hose Reels

Trunola Pty. Ltd. A.C.N. 001 853 550 T/A Quik Spray
P.O. BOX 825 MOOLOOLABA QUEENSLAND 4557
FREECALL: TEL & FAX: 1800 645688 MOBILE: 018 884679

Why invest in a QUIK SPRAY remote control retractable hose reel system?

Quik Spray is AUSTRALIAN INVENTED, AUSTRALIAN MADE, AND AUSTRALIAN OWNED.

A QUIK SPRAY system will offer you...

HUGE TIME SAVINGS: Sprayers boast an increase of double, and more, in the area sprayed per day. This represents a **doubling of productivity !**

ONE PERSON OPERATION: Because the sprayer has complete control of the hose with the touch of a button on the belt, the need for a second person to wind up or manage the hose is eliminated thus **doubling efficiency !**

REDUCES FATIGUE: Since the hose rewind is strong enough to assist the operator up, even steep hills, and there is no longer a need to wind up hoses manually, the operator experiences far less physical exertion. This benefit integrates with the philosophy outlined in all **Workplace Health and Safety recommendations**.

REDUCES FRUSTRATION: As the sprayer is always at the end of the spray hose it cannot become caught on sticks, rocks, or become entangled. Not only does this greatly **improve efficiency** but it also contributes to **positive staff moral.**

The organisations below use, and are extremely pleased with, their Quik Spray investment.

State Forests of New South Wales
National Parks and Wildlife Service
Dept. of Conservation and Environment (Vic.)
Dept. of Conservation and Land Management (W.A.)
Dept of Environment and Heritage (Qld.)
Dept. of Primary Industries and Fisheries (N.T.)
A.C.T. Parks and Conservation Service
Noxious Plants County Councils - throughout N.S.W.
Rail , Road, and Water management authorities across Australia
Local Shire Councils - throughout Qld. , N.S.W.
Noxious Plants spraying contractors - throughout Australia and New Zealand

Remember: The BENEFITS you gain by investing in the Quik Spray system means it pays for itself in a short period of time!
(No other spray system in the world can boast this !)

DRY PRODUCT TECHNOLOGY & ENVIRODRUMS

Bill Hannaford
Research & Development Officer
P O Box 129
SOUTH WAGGA NSW 2650
Phone: 069 21 5430 Fax: 069 21 5242

The Problem with Pesticides

Most people these days have concerns when using pesticides. How toxic is the chemical to me and how toxic will it be the environment?

Another major concern people have is disposing of pesticide drums. The government is now trying to reduce the numbers of empty drums on farms and at depots and Nufarm, as one of Australia's largest pesticide manufacturers and distributors is investing considerable time and effort into tackling this problem.

Dry Products

Already Nufarm has a large range of dry products on the market as powders in water soluble bags and granules. One of the major advantages with dry products is that if the pesticide is split there is a much reduced danger of soil contamination. The other major advantage is the one of container disposal as dry formulations are packed in cardboard boxes and these have obvious disposal advantages over plastic or metal drums.

Baton

Nufarm has recently released Baton, which is 2,4-D Amine as a wettable powder in pre measured water soluble bags. Baton is the same form of 2,4-D as Nufarm's Amicide 500 - the Dimethylamine sale - and it also has the same low volatility. However it is over one and a half times as strong with 800g/kg of active 2,4-D. This means to achieve similar areas of weed control, you use less volume of product, you have half the weight to handle and you don't have the drum disposal problems.

In the past people have had problems getting wettable powders from the packet into the tank and out through the nozzles. However with Baton, because of the water soluble bags, there are no dust problems, no spillage problems and if you follow the simple mixing procedure there are no mixing or blockage problems. Nufarm recommends partly fill the tank to about 20%, add the water soluble bags, allow bags to soak for at least 3 minutes while adding water to half fill mark, commence agitation then complete filling with water.

Deep Filter Baskets and Venturi Systems

To increase the mixing of dry products Nufarm is promoting the use of Deep Filter Baskets and Venturi Systems. Some people have been discouraged when using dry products because they have caused filter and spray unit blockages. Deep Filter Baskets sit inside the tank and aid the mixing of water soluble bags by keeping them in the middle of the tank not at the bottom near the outlet. Venturi Systems have been designed to increase

the water flow at a point where the dry products such as granules and water are mixed together. This increase in water flow causes the granules to dissolve much more than standard agitation.

Nufarm Envirodrum

Nufarm's commitment to safer handling and transport of herbicides, and reduction of unwanted containers in the environment, is gaining pleasing support from agricultural chemical users right across Australia with the release Nufarm's Envirodrum. The Envirodrum is fully sealed, one hundred and ten litre returnable bulk container and offers an alternative to the standard 20 or 200 litre non returnable drums. The Envirodrum has the advantage of reducing operator exposure as there is no pouring or rinsing of chemical containers if the Envirodrum is connected via the pump and a hose to the spray tank. Products that are available in this environmentally friendly bulk container include Amicide 500, Glyphosate 360, Glyphosate CT, Nugrass and Trifluralin with Estercide 800 being made available in the near future.

--ooOoo--

ANNOUNCEMENT
NOXIOUS PLANTS OFFICERS ASSOCIATION OF N.S.W.

ELECTION OF OFFICERS SEPTEMBER 1995

Association office bearers, Committee and life members:-

President	Kim Bellairs
Secretary	Rob Waller
Treasurer	Eddie Lanting
Vice President	Dave Richards
Assistant Secretary	Val Stubbs
Assistant Treasurer	Terry Eyles
Publicity Officer	Terry Schmitzer

COMMITTEE (Regional Delegates)

Region 1	Bruce Scott
Region 2	Jim Cherry
Region 3	John Chapman
Region 4	Ian Borrowdale
Region 5	Dick Honeyman

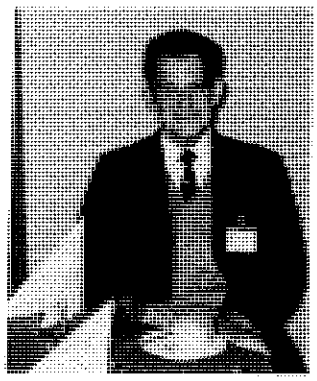
LIFE MEMBERS

1993	Don Armstrong
1993	Ron Nalder
1995	Wal Samuels
1995	John Attley
1995	Jack Fahey
1995	Bob Leech
1995	Brian Abra

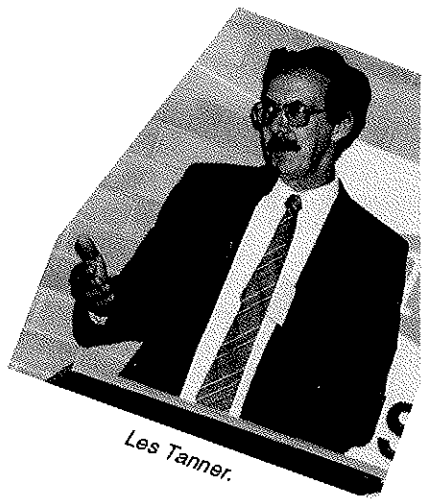
Congratulations to all concerned!

The following pages are something of a "rogues' gallery" from the night of the official Conference Dinner - Thursday, 21 September 1995:

Dick Honeyman - gathering material for a new poem.

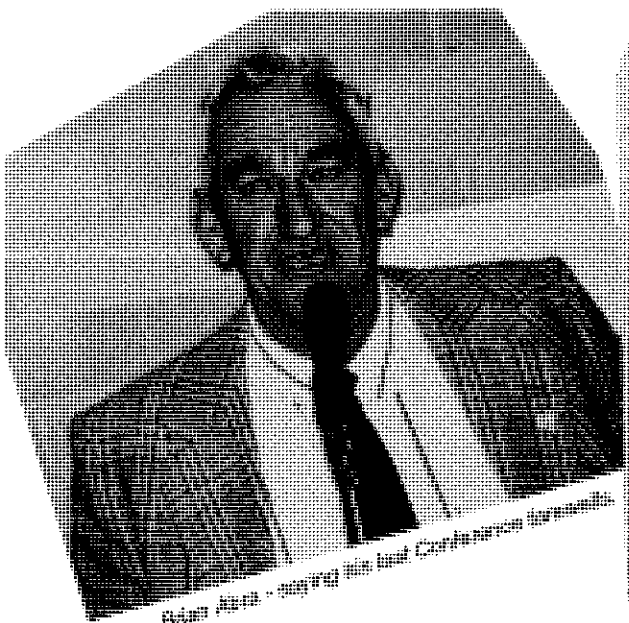


Dick Honeyman - ready to go!



Les Tanner.

Peter Gorham, Chris Evans, and Kim Bellairs being entertained by John Abbott.



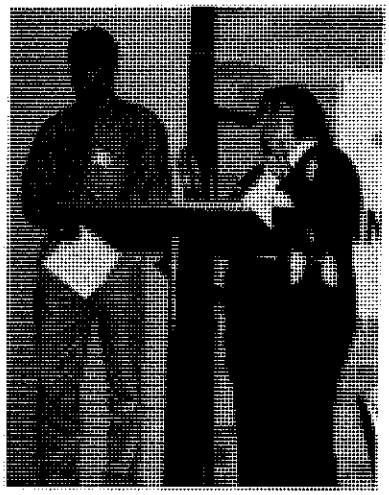
Dick Honeyman, Jock Colwell - observing the action.

Debbie Orton from the Academy looking after Dave Richards and Graham Mathews.

Robbie Cheetham and Jock Colwell.

Waiting to go back into school.

Chris Evans

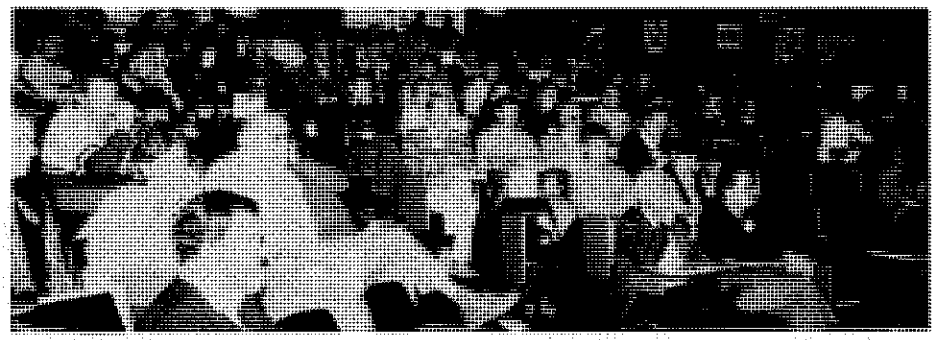


Bill Hannaford presenting Melinda Sargeant with her Nufarm prize for winning the weed identification contest.

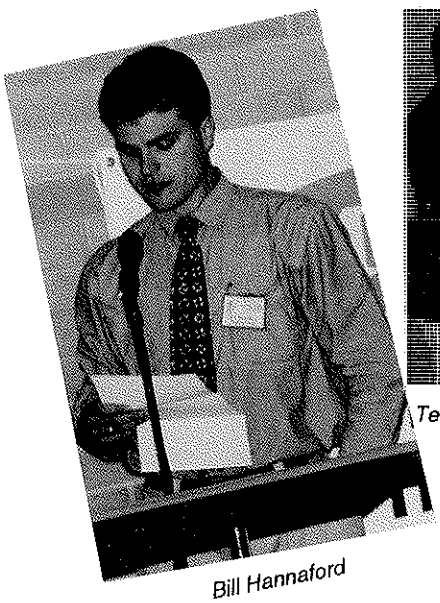
Ian Borrowdale receiving his Weed Society Prize from David Theriault.

Good fellowship...

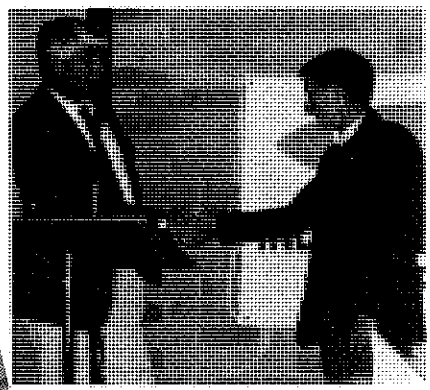
Bernie Horsefield presenting the Dupont/Macspred Travel Award to Dick Honeyman.



School's in at the 8th Biennial Noxious Weeds Conference.



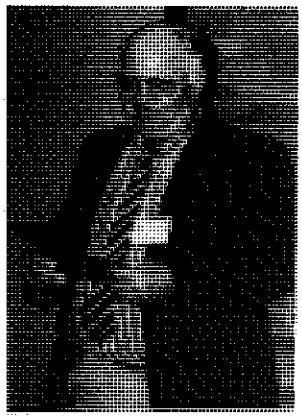
Bill Hannaford



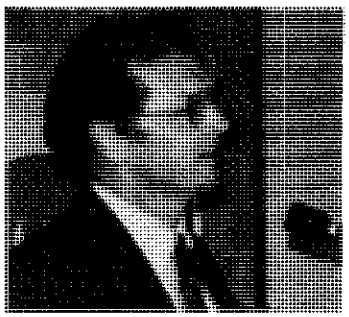
Terry Eyles receiving the Innovative Ideas Award from John Abbott.

Chairman for the night - Bob Trounce.

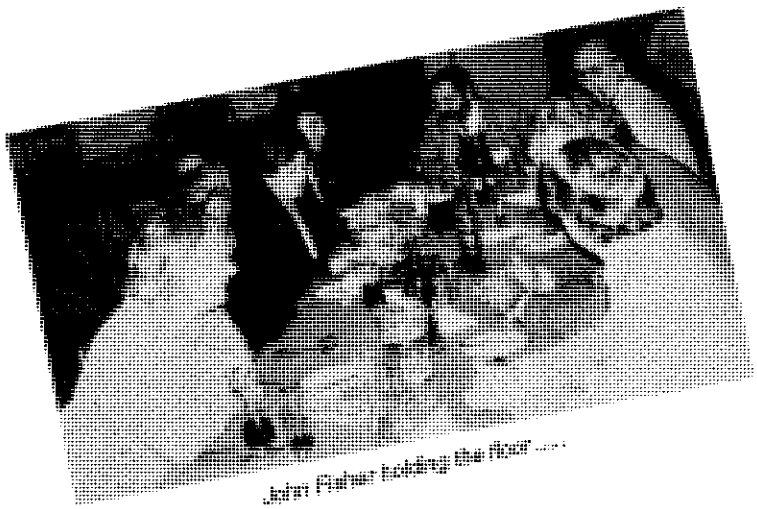
Geoff Keech - announcing the Dupont/Macspred travel Award winner.



Rob Waller - receiving his new watch so he won't miss the bus at the next Conference!



David Theriault



Peter Gray presenting Ron Roberts with his "Achievement Award"

John Toth - looks like he found the slivovitz!

ALLIGATOR WEED

IT CHOKES RIVERS AND IRRIGATION SYSTEMS AND IS EXTREMELY DIFFICULT TO CONTROL

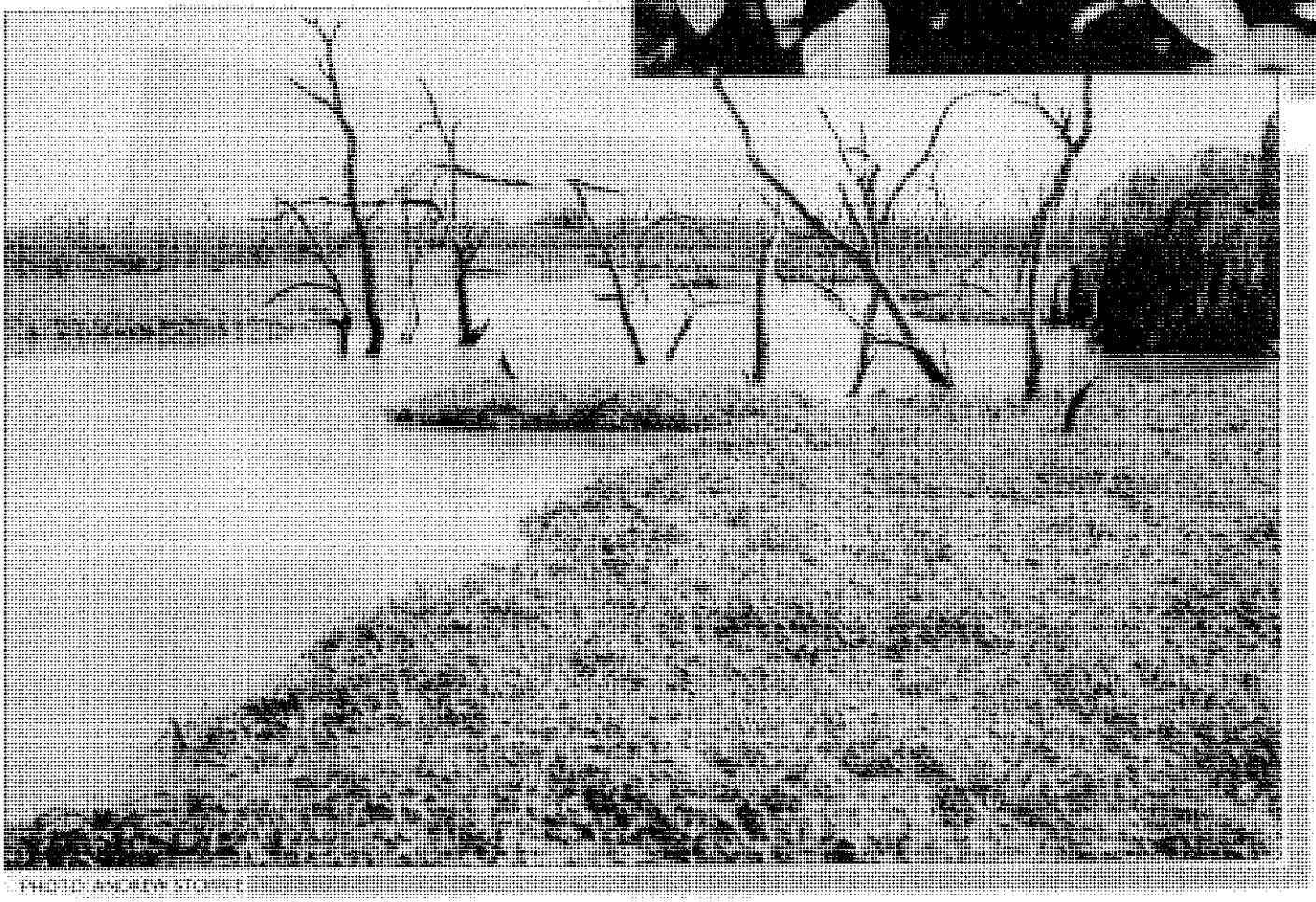


PHOTO: ANDREW STORRIE

"CAN YOU IDENTIFY IT?"

If you see any plant that looks like this contact NSW Agriculture or your Local Council *IMMEDIATELY*

NSW Agriculture
Alligator Weed Taskforce

MURRAY-DARLING BASIN COMMISSION

PARTHENIUM WEED
ALLIGATOR WEED
INFORMATION BROCHURES
available from
NSW Agriculture
Inquiries to Bob Trounce
NSW Agriculture
LB 21, Orange 2800

Noxious Weed

Parthenium

Weed

▶ spreads rapidly

▶ affects human and animal health

▶

▶ affects agricultural productivity

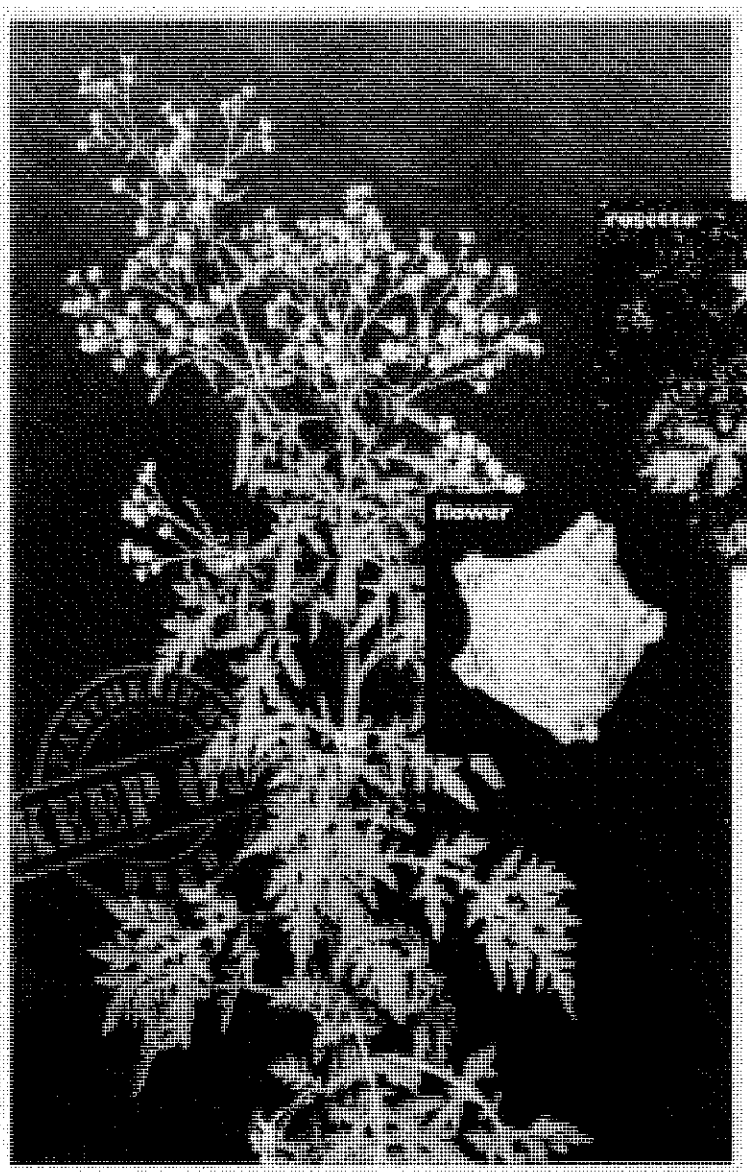
▶ reduces land values

NSW Agriculture

NEW SOUTH WALES

Parthenium Weed Exclusion Zone

KEEP OUR STATE PARTHENIUM FREE



This noxious weed

- Spreads rapidly
- Affects human and animal health
- Is difficult and expensive to control
- Affects agricultural productivity
- Reduces land values

Warning

A single plant can produce 15,000 seeds!

Do not handle suspect plants. Report any findings to authorities immediately.

For further information, contact your Council Weeds Inspector on

( ) .....

or NSW Agriculture.

NSW Agriculture

Mr	ABBOTT	John	DuPont (Aust.) Ltd	Advisor	18 Perry Ave	SPRINGWOOD	2777	(047) 511 135	(047) 515 748
Mr	ABER	David	Shoalhaven City Council	Mgr Support Services	PO Box 42	NOWRA	2541	(044) 293 111	
Mr	ABRA	Brian	Moree Plains Shire Council	Chief Weeds Officer	PO Box 420	MOREE	2400	(067) 529 533	(067) 522 425
Mr	ACKARY	David	Upper Macquarie County Council	Nox Weeds Insp	PO Box 703	BATHURST	2795	(063) 314 200	(063) 312 121
Mr	ADAMS	Kevin	Murrumbidgee Shire Council	Noxious Plants Inspector	PO Box 5	DARLINGTON POINT	2706	(069) 684 166	(069) 684 252
Ms	ADAMSON	Lee	ACT Agriculture	Ranger	PO Box 1038	TUGGERANONG	2901	(06) 207 2276	(06) 207 2268
Cr	ANDERSON	Len	Central Murray County Council	Councillor	Balboora	FINLEY	2714	(058) 830 221	(058) 830 232
Mr	ANDERSON	Rodney	Urana Shire Council	Nox Plants Inspector	PO Box 55	URANA	2645	(069) 208 205	(069) 208 060
Mr	ASHTON	Dennis	Sydney Water	Catchment Prot. Officer	PO Box 365	GUILDFORD	2161	(02) 795 4490	(02) 795 4322
Mr	AUSTIN	Dan	Eagle Environ. Services P/L	Agronomist	PO Box 126	LIDCOMBE	2141	(02) 748 0066	(02) 647 2608
Mr	BALDWIN	Don	Upper Macquarie County Council	Chief Weeds Officer	PO Box 703	BATHURST	2795	(063) 314 200	(063) 312 121
Mr	BANFFY	Chris	Natl Parks & Wildlife Service	Pest Species Officer	PO Box 330	OBERON	2787	(063) 361 972	
Mr	BARLOW	Peter	Mulwaree Shire Council	Weeds Officer	PO Box 148	GOULBURN	2580	(048) 211 933	(048) 219 668
Mr	BATE	Tony	Illawarra Dist (Nox.) Weeds Auth.	Plant Operator/Inspector	PO Box 148	KIAMA	2533	(042) 331 129	
Mr	BATTENALLY	Steve	Wakool Shire Council	Noxious Weeds Inspector	PO Box 40	MOULAMEIN	2733	(058) 875 007	(058) 875 103
Mrs	BELLAIRS	Kim	Far North Coast County Council	Inspector	PO Box 168	KYOGLE	2474	(066) 335 178	
Mr	BISHOP	Tim	DuPont (Aust) Ltd	Product Manager	PO Box 930	NORTH SYDNEY	2059	(02) 992 36111	(02) 992 36132
Mr	BLACKMORE	Phil	NSW Agriculture	Act. Nox . Plants Adv.Offcr	PO Box 991	ARMIDALE	2350	(067) 737 288	(067) 728 664
Mr	BORROWDALE	Ian	Shoalhaven City Council	CWO	PO Box 42	NOWRA	2541	(044) 293 111	(044) 236 373
Mr	BOULTON	Mike	Nox. Weeds Adv Comm.	Member (DWR)	PO Box 717	DUBBO	2830	(068) 842 560	(068) 840 096
Mr	BOURKE	Barry	Newcastle City Council	Pest & Weed Control	PO Box 489	NEWCASTLE	2300	(049) 299 356	(049) 293 728
Mr	BOWLES	Alan	Nymboida Shire Council	Noxious Weeds Officer	PO Box 51	SOUTH GRAFTON	2461	(066) 421 866	(066) 431 817
Mr	BOWLING	Scott	Ulmarra Shire Council	Weeds Inspector	PO Box 13	ULMARRA	2462	(066) 445 303	(066) 445 366
Mr	BRACKEN	John	Newcastle City Council	Supervisor	PO Box 489	NEWCASTLE	2300	(049) 299 356	(049) 293 728
Mr	BROOKS	Michael	Narrabri Shire Council	Weeds Officer	PO Box 261	NARRABRI	2390	(067) 921 699	
Mr	BROWN	Paul	Mulwaree Shire Council	Weeds Officer	PO Box 148	GOULBURN	2580	(048) 211 933	(048) 219 668
Mr	BULLEY	Brian	Narromine Shire Council	Noxious Weeds Inspector	PO Box 115	NARROMINE	2821	(068) 891 322	(068) 892 579
Mr	BUNN	Ken	Port Stephens Council	Weeds & Pest Control Officer	PO Box 42	RAYMOND TERRACE	2324	(049) 831 333	(049) 863 612
Mr	BURFORD	Brian	Griffith City Council	Chief Weeds Officer	PO Box 485	GRIFFITH	2680	(069) 621 277	(069) 627 161
Mr	BURTON	Kevin	Wollondilly Shire Council	Nox Weeds Officer	PO Box 21	PICTON	2571	(046) 771 326	(046) 772 339
Mr	BUSHBY	Alan	Upp Hunter C. C. Weeds Auth.	Gen Mgr/Chief Weeds Officer	PO Box 122	MUSWELLBROOK	2333	(065) 432 866	(065) 433 790
Mr	BYWATER	Brian	Dubbo City Council	Manager Landcare	PO Box 81	DUBBO	2830	(068) 814 270	(068) 840 587
Ms	CALDICOT	Jane	Nox. Weeds Adv. Comm.	TCM	PO Box 108	WAUCHOPE	2446	(065) 853 722	(065) 852 242
Ms	CARDER	Jane	ACT City Parks	SOC	PO Box 1119	TUGGERANONG	2901	(06) 207 2525	(06) 207 2502
Mr	CARROLL	Timothy	Campbelltown City Council	Environ. Prot. Officer	PO Box 57	CAMPBELLTOWN	2560	(046) 201 510	(046) 210 496
Mr	CHAPMAN	Ian	Mid Western County Council	Chief Weeds Officer	PO Box 138	MUDGEE	2850	(063) 721 300	(063) 726 348
Mr	CHEETHAM	Robbie	Central Murray County Council	General Manager	1 Druitt Court	FINLEY	2713	(058) 812 139	(058) 812 139
Mr	CHERRY	Jim	Central Northam County Council	Noxious Weed Control Mgr	PO Box 155	QUIRINDI	2343	(067) 461 755	(067) 663 038
Mr	CHRISTIAN	Phillip	NSW Agriculture	Supervisor	RMB 944	TAMWORTH	2340	(067) 631 175	(067) 631 222
Mr	CLANCY	Brian	Lockhart Shire Council	Noxious Weeds Inspector	PO Box 21	LOCKHART	2656	(069) 205 305	(069) 205 247
Mr	CLARK	Alan	Narrandera Shire Council	Nox Weeds Inspector	PO Box 39	NARRANDERA	2700	(069) 592 277	(069) 591 884

Mr	CLARK	Scot	Rapid Map Australia	Chief Programming Engr	2 Park Drive	BUNDOORA	3083	(03) 9455 1699	(03) 9455 1990
Mr	CLINTON	Don	Snowy River Shire Council	Weeds Officer	2 Myack St	BERRIDALE	2628	(064) 563 251	(064) 563 117
Ms	COLGAN	Kathy	Aust Nature Consvtn Agcy	Asst Dir Invasive Sp Pgm	PO Box 636	BELCONNEN	2601	(06) 250 0273	(06) 250 0314
Cr	COLLINS	Tim	Bega-Valley Shire Council	Mayor	PO Box 492	BEGA	2550	(064) 929 400	(064) 923 323
Cr	COLLINSON	Geoff	Yarrowlumla Council	Councillor	PO Box 112	QUEANBEYAN	2620	(06) 238 2278	
Mr	COLWILL	Jock	Coolamon Shire Council	Noxious Weeds Officer	PO Box 101	COOLAMON	2701	(069) 273 206	(069) 273 168
Mr	CONE	Tim	UHCC Weeds Authority	Dist Weeds Officer	PO Box 122	MUSWELLBROOK	2333	(065) 432 866	(065) 433 790
Mr	CONLAN	John	Lockhart Shire Council	Noxious Weeds Inspector	PO Box 21	LOCKHART	2656	(069) 205 305	(069) 205 247
Mr	COOK	Tony	NSW Agriculture	Tech Offcr (Weeds)	RMB 944	TAMWORTH	2340	(067) 631 100	(067) 631 222
Mr	CORCORAN	Jason	Sthn Slopes Nox Plants Auth	Nox Plants Inspector	PO Box 3	BOOROWA	2586	(063) 853 189	(063) 853 562
Mrs	COREY	Sharon	CSIRO Entomology	Scientific Liaison Officer	GPO Box 1700	CANBERRA	2601	(06) 246 4136	(06) 246 4177
Cr	CRAMERI	Ken	Penrith City Council	Councillor	PO Box 60	PENRITH	2751	(047) 327 633	(047) 327 628
Ms	CUELHO	Pam	NSW Agriculture (NWAC)	Secretary	Locked Bag 21	ORANGE	2800	(063) 913 159	(063) 913 605
Mr	CUMMINS	Joe	Dept Land & Water Conservation	CoOrdinator Reserves Man	PO Box 53	ORANGE	2800	(063) 638 293	(063) 623 896
Mr	DAVIES	Rob	Temora Shire	Weed Inspector	16 View St	TEMORA	2666	(069) 771 099	(069) 772 996
Mr	DAWSON	Peter	Central Northam County Council	Weeds Officer	PO Box 155	QUIRINDI	2343	(067) 461 755	(067) 663 038
Mr	DEANE	Peter	Tallaganda Shire	Chief Weeds Officer	PO Box 91	BRAIDWOOD	2622	(048) 422 225	(048) 422 669
Mr	DEATH	Tom	Cowra Shire Council	Noxious Plants Inspector	PO Box 342	COWRA	2794	(063) 410 148	(063) 411 031
Mr	DELLOW	Jim	NSW Agriculture	Agronomist (Weeds)	AR & VC	ORANGE	2800	(063) 913 800	(063) 913 883
Mr	DODGSON	Allan	Lachlan Shire Council	Noxious Weeds Inspector	PO Box 216	CONDOBOLIN	2877	(068) 952 377	(068) 953 478
Mr	DODKIN	Mike	Natl Parks & Wildlife Service	Pest Species Officer	PO Box 61	PORT MACQUARIE	2444	(065) 842 203	
Mr	DONKIN	Paul	Workcover Authority of NSW	Dept. Professional Officer	5A Pioneer Av	THORNLEIGH	2120	(02) 484 6655	(02) 980 6849
Mr	DONOHOE	Robert	Grafton City Council	Noxious Plants Officer	PO Box 24	GRAFTON	2460	(066) 422 266	(066) 427 647
Mrs	DONOHOE	Susan	Grafton City Council		PO Box 24	GRAFTON	2460	(066) 422 266	(066) 427 647
Mr	DRURY	Dean	Greater Taree City Council	Noxious Weed Officer	PO Box 482	TAREE	2430	(065) 913 108	(065) 913 311
Mr	DWYER	Brian	Upper Macquarie County Council	Assistant General Manager	PO Box 703	BATHURST	2795	(063) 314 200	(063) 312 121
Mrs	EDMONDS	Maria	Port Stephens Council	Snr Weeds/Pests Cont Offcr	PO Box 42	RAYMOND TERRACE	2324	(049) 831 333	(049) 872 612
Mr	ELLISON	Peter	Tumut Shire Council	Nox Weeds Inspector	PO Box 123	TUMUT	2720	(069) 471 022	(069) 473 999
Mr	ELMER	Frank	State Rail Authority	Herbicide Optr	126 Church St	PARRAMATTA	2150	(02) 843 9043	
Mr	ENGLAND	Ken	Natl Parks & Wildlife Service	Technical Officer	PO Box 351	MUSWELLBROOK	2333	(065) 433 533	(065) 411 085
Mr	ENNIS	John	Nambucca Shire Council	Noxious Weeds Inspector	PO Box 177	MACKSVILLE	2447	(065) 682 555	(065) 682 201
Mr	ENSBEY	Rod	NSW Agriculture	Supervisor	PO Box 285	GRAFTON	2460	(066) 420 448	(066) 427 251
Mr	EVANS	Chris	Monsanto Aust Ltd	Sales Specialist	PO Box 278	HARBORD	2096	(02) 939 6079	
Mr	EYLES	Terry	Wyong Shire Council	Noxious Weeds Officer	PO Box 20	WYONG	2259	(043) 531 333	(043) 512 098
Mr	FALLOW	Keith	Monsanto Aust Ltd	Prod. Dev. Officer	PO Box 156	BENDIGO	3555	(054) 437 415	
Cr	FANNING	Ron	Cabonne Shire Council	Councillor	PO Box 17	MOLONG	2866	(063) 668 303	(063) 668 799
Mr	FERRIS	Greg	State Rail Authority	A/Agronomist	126 Church St	PARRAMATTA	2150	(02) 843 9043	
Mr	FERRY	Bruce	Central Murray County Council	Noxious Plants Inspector	Wells St	FINLEY	2713	(058) 812 139	(058) 812 139
Mr	FERRY	Eddie	Fairfield City Council	Weeds Officer	PO Box 21	FAIRFIELD	2165	(02) 725 0394	(02) 609 3257
Mr	FIELD	Bob	Goulburn City Council	Noxious Weeds Inspector	PO Box 725	GOULBURN	2580	(048) 230 409	(048) 222 081
Mr	FISACARO	Joe	Central Murray County Council	Noxious Plants Inspector	PO Box 909	DENILIQUIN	2710	(058) 812 139	(058) 812 139

Mr	FISHER	John	NSW Agriculture (NWAC)	Program Leader (Weeds)	Locked Bag 21	ORANGE	2800	(063) 913 172	(063) 913 605
Mr	FISHPOOL	Ken	NSW Agriculture	Assist. to Chief	Locked Bag 21	ORANGE	2800	(063) 913 318	(063) 913 206
Mr	FITZGERALD	John	New England Tblnds C.C.	District Weeds Officer	PO Box 881	ARMIDALE	2350	(067) 711 700	(067) 711 893
Mr	FRANCIS	Ron	Blue Mountains City Council	Noxious Weeds Officer	PO Box 189	KATOOMBA	2780	(047) 820 539	(047) 820 589
Cr	FRASER	Bob	Jerilderie Shire Council	Councillor	PO Box 96	JERILDERIE	2716	(058) 861 200	(058) 861 701
Mr	GAMBLE	Jeff	MIA Rural Services	Wholesale Manager	PO Box 1594	GRIFFITH	2680	(069) 642 999	(069) 627 851
Mr	GARDINER	Mark	Wagga Wagga City Council	Chief Noxious Weeds Officer	PO Box 20	WAGGA WAGGA	2650	(069) 235 257	(069) 235 396
Mr	GEYER	Robert	Workcover Authority of NSW	Lab. Services Unit Coord	5A Pioneer Av	THORNLEIGH	2120	(02) 484 6655	(02) 980 6849
Mr	GILES	Peter	Bogan Shire Council	Weeds Inspector	PO Box 221	NYNGAN	2825	(068) 321 503	(068) 321 965
Mr	GORDON	John	New England Tblnds C.C.	District Weeds Officer	PO Box 881	ARMIDALE	2350	(067) 711 700	(067) 711 893
Mr	GORHAM	Peter	NSW Agriculture	Nox. Plants Adv. Offcr	PO Box 129	COWRA	2794	(063) 42 2122	(063) 411 816
Mr	GORRINGE	David	Upper Macquarie County Council	General Manager	PO Box 703	BATHURST	2795	(063) 314 200	(063) 312 121
Mr	GOULSTON	Richard	Ku-Ring-Gai Municipal Council	Regulatory Officer	PO Box 15	GORDON	2072	(02) 498 0888	(02) 498 0880
Mr	GRACE	Barry	Cootamundra Shire Council	Noxious Weeds Inspector	PO Box 420	COOTAMUNDRA	2590	(069) 422 744	(069) 423 690
Mr	GRAY	Andrew	Central Murray County Council	Noxious Plants Inspector	87 Russell St	DENILIQUIN	2710	(058) 812 139	(058) 812 139
Mr	GRAY	Peter	NSW Agriculture	Nox. Plants Adv. Offcr	PO Box 865	DUBBO	2380	(068) 811 338	(068) 811 295
Mr	GREEN	Robert	State Rail Authority	Technical Services Manager	PO Box 1272	WOLLONGONG	2500	(042) 235 592	(042) 269 963
Mr	GRIMM	Anthony	Cooma-Monaro Shire	Weeds Officer	PO Box 714	COOMA	2630	(064) 501 777	(064) 501 799
Mr	GUNTHER	Jim	State Rail Authority	Tech Officer - Veg	PO Box 1017	DUBBO	2830	(068) 812 169	(068) 812 168
Mr	HANNAFORD	Bill	Nufarm Ltd	Res & Devel	PO Box 129	STH WAGGA WAGGA	2650	(069) 215 430	(069) 215 242
Mr	HANSEN	Phil	Queanbeyan City Council	Noxious Weeds Inspector	PO Box 90	QUEANBEYAN	2621	(015) 488 726	(06) 298 0296
Mr	HARDING	Graham	Eurobodalla Council	Snr Nox. Weeds Inspector	PO Box 99	MORUYA	2537	(044) 741 269	(044) 741 234
Mr	HARTNETT	Brendan	Shires Association of NSW	Director Policy	GPO Box 7003	SYDNEY	2001	(02) 299 7711	(02) 262 1049
Mr	HAWKES	Norm	State Forests of NSW	Forest Practices Forester	Locked Bag 21	PENNANT HILLS	2120	(02) 980 4557	(02) 980 7042
Mr	HAYER	Graham	Agric. Accessories P/L	Manager	PO Box 71	RAPPVILLE	2469	(066) 667 951	(066) 667 950
Mr	HAYES	Ken	Coffs Harbour City Council	Chief Weeds Officer	L Bag 155	COFFS HARBOUR	2450	(066) 519 032	(066) 514 449
Mr	HIBBERSON	Neil	Holbrook Shire Council	Weeds Officer	PO Box 99	HOLBROOK	2644	(060) 362 155	(060) 362 683
Mr	HILLIER	Dennis	Gunning Shire Council	Chief Weeds Officer	PO Box 42	GUNNING	2581	(048) 45 1312	(048) 451 426
Mr	HOCKING	Doug	NSW Agriculture (NWAC)	Program Manager	Locked Bag 21	ORANGE	2800	(063) 913 150	(063) 913 605
Mr	HODGE	Peter	NSW Agriculture	Supervisor	PO Box 1700	CANBERRA	2601	(02) 246 4340	(02) 246 4177
Mr	HONEYMAN	Dick	Jerilderie Shire Council	Snr Nox. Weeds Inspector	PO Box 96	JERILDERIE	2716	(058) 861 200	(058) 861 701
Mr	HOPTON	Chris	Great Lakes Council	Noxious Plant Officer	PO Box 45	FORSTER	2425	(065) 545 100	(065) 548 174
Mr	HORSBURGH	John	Culcairn Shire Council	Noxious Plants Officer	PO Box 94	CULCAIRN	2660	(060) 298 588	(060) 298 607
Mr	HORSFIELD	Bernie	Macspred Pty Ltd	Director	PO Box 6887	WETHERILL PARK	2164	(02) 756 4433	(02) 756 4435
Mrs	HORSFIELD	Shirley	Macspred Pty Ltd		PO Box 6887	WETHERILL PARK	2164	(02) 756 4433	(02) 756 4435
Mr	HORTON	Jonathan	ANU	Student/Author	5 Broadbent St	SCULLIN	2614	(06) 255 1819	
Mr	HOWARD	Alastair	NP&WS (NWAC)	Executive Director Operations	PO Box 1967	HURSTVILLE	2220	(02) 585 6302	(02) 585 6455
Mr	HOWARD	Dennis	Nyngan Rural Lands Prot. Board	Reserves Foreman	PO Box 45	NYNGAN	2825	(068) 321 008	(068) 321 635
Cr	HOWARTH	John	Upper Macquarie County Council	County Chairman	PO Box 703	BATHURST	2795	(063) 314 200	(063) 312 121
Mr	HOWE	Terry	Sthn Slopes Nox Plants Auth	Nox Plants Inspector	PO Box 3	BOOROWA	2586	(063) 853 189	(063) 853 562
Mr	HOWSE	Ned	J O'Malley & Co	Ind Sales Manager	45 Prime Dr	SEVEN HILLS	2147	(02) 838 9188	(02) 674 2078

Mr	INGOLD	Graham	Gundagai Shire Council	Noxious Weeds Officer	Sheridan St	GUNDAGAI	2722	(069) 441 266	(069) 441 475
Mr	IRONS	Jim	Narrabri Rural Lands Prot. Board	Ranger	PO Box 18	NARRABRI	2390	(067) 922 533	(067) 921 738
Mr	JACKSON	Peter	Natl Parks & Wildlife Service	Pest Species Officer	PO Box 39	COONABARABRAN	2357	(068) 421 311	(068) 422 124
Mr	JOHNSON	Ian	Cobbett P/L	Sales Manager	PO Box 240	HORNSBY	2077	(02) 477 7944	(02) 477 7363
Mr	JOHNSTON	Lionel	Pacific Power	Land Management Officer	Wang Pwr Stn	WALLERAWANG	2845	(063) 528 641	(063) 528 740
Mr	JONES	Matt	Natl Parks & Wildlife Service	District Pest Species Officer	PO Box 44	SUTHERLAND	2232	(02) 542 0615	(02) 542 1420
Mr	KANE	Mike	NSW Agriculture	Inspector	PO Box 209	MOREE	2400	(067) 525 111	(067) 524 859
Mr	KARLSON	David	Hawkesbury Rvr CC	Snr Weeds Insp	6 Walker St	SOUTH WINDSOR	2756	(045) 775 573	(045) 775 653
Mr	KAYE	David	Sydney Water	Weeds Officer	C/- Bargo PO	BARGO	2574	(046) 841 209	(046) 841 963
Mr	KEECH	Geoff	Macspred Pty Ltd	Sales Supervisor	PO Box 6887	WETHERILL PARK	2164	(02) 756 4433	(02) 756 4435
Mr	KELLY	Ian	Castlereagh Macq C Council	Chairman	PO Box 31	WALGETT	2832	(068) 281 399	
Mr	KERRISON	John	Wingecarribee Shire Council	Chief Weeds Officer	PO Box 141	MOSS VALE	2577	(048) 681 066	(048) 692 040
Mr	KNELLER	Stephen	North West Weeds	Noxious Plants Inspector	PO Box 93	WARIALDA	2402	(067) 291 016	(067) 291 400
Mr	LANE	Allan	Newcastle City Council	Pest & Weed Control	PO Box 489	NEWCASTLE	2300	(049) 299 356	(049) 293 728
Mr	LANGRIDGE	Alisdair	NSW Agriculture	Media Officer	PO Box 657	MASCOT	2020	(02) 364 7325	(02) 364 7339
Mr	LANTING	Eddie	Gosford City Council	Weeds Officer	PO Box 21	GOSFORD	2260	(043) 258 432	(043) 676 277
Cr	LAWRENCE	Don	Cabonne Council	Councillor	PO Box 17	MOLONG	2866	(063) 668 303	(063) 668 799
Mr	LE BROCQUE	Steven	Comm Rehab Open Trng Ntwk	Student	8 Grenfell St	FORBES	2871	(068) 522 831	
Mr	LEDDY	Paul	Kempsey Shire Council	Noxious Weeds Inspector	PO Box 78	WEST KEMPSEY	2440	(065) 626 077	(065) 628 902
Mr	LEECH	Bob	Crookwell Shire Council	Landcare Officer	PO Box 10	CROOKWELL	2583	(048) 321 022	(048) 322 066
Dr	LEYS	Andrew	Natl Parks & Wildlife Service	State Coordinator Pest Man	PO Box 1967	HURSTVILLE	2220	(02) 585 6651	(02) 585 6401
Mr	LINDLEY	Gordon	Gundagai Shire Council	Mayor	Sheridan St	GUNDAGAI	2722	(069) 441 266	(069) 441 475
Mr	LODGE	Alan	Balranald Council	Weeds Officer	PO Box 120	BALRANALD	2715	(050) 201 300	(050) 201 620
Mr	LONGWORTH	Jim	Nox. Weeds Adv. Comm.	SRA	2 The Bvd	CHELTENHAM	2119	(02) 224 3106	
Mrs	LOUGHRAN	Ann	Hunter Inst of Tech (TAFE)	Teacher of Horticulture	Tiral Street	CHARLESTOWN	2290	(049) 438 233	(049) 434 275
Mr	LUTSCHINI	Paul	NSW Agriculture	Supervisor	PO Box 174	MUDGEE	2850	(063) 724 700	(063) 726 870
Mr	LYNCH	Lew	Far North Coast County Council	Weeds Inspector	PO Box 238	CASINO	2470	(066) 622 396	(066) 625 511
Ms	LYNCH	Jo	Ku-ring-gai Municipal Council	Bshland Rehab Officer	818 Pacific Hwy	GORDON	2072	(02) 498 0888	(02) 498 0880
Mr	LYONS	Mitchell	Cabonne Council	Noxious Plants Inspector	PO Box 17	MOLONG	2866	(063) 668 303	(063) 668 799
Mr	MAGUIRE	Alan	NSW Agriculture	Supervisor	RMB 944	TAMWORTH	2340	(067) 631 131	(067) 631 222
Mr	MALLARD	Peter	Natl Parks & Wildlife Service	Snr Field Officer	PO Box 1189	QUEANBEYAN	2620	(06) 298 0357	(06) 299 4271
Dr	MALLEN-COOPER	Jane	Nox. Weeds Adv Comm.	Member (EPA)	L Bag 1502	BANKSTOWN	2200	(02) 795 5380	(02) 7A95 5004
Mr	MARR	Jerry	Hay Shire Council		PO Box 141	HAY	2711	(069) 931 003	
Mr	MARTIN	Philip	Greater Taree City Council	Snr Environ. Health Offcr	PO Box 482	TAREE	2430	(065) 913 108	(065) 913 311
Mr	MASSEY	John	Goulburn City Council	Director Environ. & Planning	PO Box 725	GOULBURN	2580	(048) 230 454	(048) 230 456
Mr	MATHEWS	Kevin	New England Tblnds C.C.	District Weeds Officer	PO Box 881	ARMIDALE	2350	(067) 711 700	(067) 711 893
Mr	MATTHEWS	Graham	Bellingen Shire Council	Chief Weeds Officer	PO Box 117	BELLINGEN	2454	(066) 551 027	(066) 552 310
Ms	McDONALD	Latarnie	NSW Agriculture	Agronomist	PO Box 1386	BATHURST	2795	(063) 334 377	(063) 334 491
Mr	McGUFFOG	Doug	McGuffog & Co Pty Ltd	Project Manager	PO Box 5470	WEST END	4101	(074) 748 100	(074) 748 252
Cr	McGUINNES	Brian	Crookwell Shire Council	Mayor	PO Box 10	CROOKWELL	2583	(048) 321 022	(048) 322 066
Mr	McKENZIE	Alan	BHP	Lands Consultant Weeds	PO Box 768	COOMA	2630	(064) 521 197	(064) 521 197

Mr	McLENNAN	Alex	Cobbett P/L	Trials & Res. Co-Ordr	PO Box 240	HORNSBY	2077	(02) 477 7944	(02) 477 7363
Mr	McPHERSON	Paul	Tumbarumba Shire Council	Noxious Weeds Officer	PO Box 61	TUMBARUMBA	2653	(069) 482 022	(069) 482 865
Ms	McRAE	Lyn	Natl Parks & Wildlife Service	Protection Systems Officer	PO Box 98	PARRAMATTA	2150	(02) 895 7420	(02) 895 7414
Mr	MERTON	Peter	Nox. Weeds Adv. Comm.	RLPB	Journeys End	BATHURST	2795	(063) 377 762	
Mr	MILHAM	Paul	NSW Agriculture	Chemist	PMB 10	RYDALMERE	2116	(02) 683 9777	(02) 630 4475
Mr	MILLER	Ian	Dept Primary Ind & Fisheries	Princ Agronomist Weeds	GPO Box 990	DARWIN	801	(089) 992 270	(089) 992 049
Mr	MILLER	Ian	Dept Primary Industry & Fisheries	Principal Agronomist Weeds	GPO Box 990	DARWIN	801	(089) 992 270	(089) 992 049
Mr	MILNE	Barney	NSW Agriculture	Field Officer	AR & VC	ORANGE	2800	(063) 913 894	(063) 913 883
Mr	MILVAIN	Hugh	NSW Agriculture	Nox. Plants Adv. Offcr	Agric. Institute	YANCO	2703	(069) 530 290	(069) 530 200
Mr	MINEHAN	Damian	Sthn Slopes Nox Plants Auth	Chief Weeds Officer	PO Box 3	BOOROWA	2586	(063) 853 189	(063) 853 562
Mr	MITCHELL	Grant	Quik Spray		PO Box 825	MOOLOOLABAH	4557	1 800 645688	(07) 849 7130
Mr	MOORE	Glen	Gundagai Shire Council	Health & Building	Sheridan St	GUNDAGAI	2722	(069) 441 266	(069) 441 475
Mr	MOORE	Dale	Lake Macquarie City Council	Vegetation Control Officer	PO Box 1906	HNTR RGN MAIL CNT	2310	(049) 210 333	(049) 587 257
Mr	MORRISON	Jim	Leeton Shire Council	Weeds Officer	PO Box 394	LEETON	2705	(069) 532 611	(069) 533 337
Mr	MULDOON	Shane	Sydney Water	Catchment Prot. Offcr	PO Box 365	GUILDFORD	2161	(02) 795 4490	(02) 795 4322
Ms	MUNRO	Pat	Macspred Pty Ltd		PO Box 6887	WETHERILL PARK	2164	(02) 756 4433	(02) 756 4435
Dr	MURRAY	David	Nox. Weeds Adv. Comm.	Member	7 Acacia Ave	GWYNVEVILLE	2500	(042) 292 171	
Mr	NAZER	Chris	ACT City Parks	SOC	PO Box 1119	TUGGERANONG	2901	(06) 207 2525	(06) 207 2502
Mr	NEAVE	David	FNCCC	Operator	PO Box 238	CASINO	2476		
Mr	NELLIGAN	Kevin	Cowra Shire Council	Noxious Plants Manager	PO Box 342	COWRA	2794	(063) 410 148	(063) 411 031
Mr	NEYLAND	Glenn	Bland Shire Council	Noxious Weed Inspector	PO Box 21	WEST WYALONG	2671	(069) 722 266	(069) 722 145
Mr	NICHOLSON	Geof	Crookwell Shire Council	Weeds Officer	PO Box 10	CROOKWELL	2583	(048) 321 022	(048) 322 066
Mr	NICHOLSON	Ellis	NSW Ste Forests (NWAC)	Member (Forests)	PO Box J19	COFFS HARBOUR	2450	(066) 528 900	(066) 512 909
Mr	NIXON	David	Severn Shire Council	Weeds Officer	PO Box 447	GLEN INNES	2370	(067) 322 555	(067) 323 634
Mr	NORRIS	Ray	Council of Camden	Weeds Inspector	PO Box 183	CAMDEN	2571	(046) 552 455	(046) 552 770
Mr	NORTH	Brendon	Bega Valley Shire Council	Nox Weeds Insp	PO Box 492	BEGA	2550	(064) 929 400	(064) 923 323
Mr	NOTT	John	Hunter Catchment Mgmt Trust	Trustee	PO Box 297	MAITLAND	2320	(049) 335 455	(049) 335 164
Mr	NUTHALL	Greg	Nox. Weeds Adv. Comm.	Member (NSW Farmers Fed)	Dutton Park	YOUNG	2594	(063) 833 271	(063) 833 256
Mr	O'CONNELL	Robert	Central Northam County Council	Weeds Officer	PO Box 155.	QUIRINDI	2343	(067) 461 755	(067) 663 038
Mr	O'LEARY	Wayne	Tallaganda Shire	Noxious Plants Inspector	PO Box 91	BRAIDWOOD	2622	(048) 422 225	(048) 422 669
Mr	OGILVIE	Allan							
Mr	OLIVE	Malcolm	Far North Coast County Council	Chairperson	PO Box 238	CASINO	2470	(066) 622 396	(066) 625 511
Mr	OLIVE	Malcolm	Nox. Weeds Adv Comm.	Shires Ass.	PO Box 238	CASINO	2470	(066) 622 396	(066) 625 511
Ms	OLSON	Samantha	Natl Parks & Wildlife Service	A/Pest Species Officer	PO Box 461	ROSE BAY	2029	(02) 337 5511	(02) 337 1303
Mr	PARKER	Terry	Yarrowlumla Council	Parks & Conservation Sup.	PO Box 112	QUEANBEYAN	2620	(06) 297 6113	(06) 297 5854
Mr	PASENOW	Eric	Dungog Shire Council	Noxious Plants Inspector	PO Box 95	DUNGOG	2420	(049) 921 224	(049) 922 044
Mr	PASQUALOTTO	Mario	MIA Rural Services	Operations Manager	PO Box 1594	GRIFFITH	2680	(069) 642 999	(069) 627 851
Mr	PATON	Bob	NSW Agriculture	Consultant	Locked Bag 21	ORANGE	2800	(063) 675 351	
Ms	PEARMAIN	Sally	NSW Agriculture	Chief Legal Officer	L Bag 21	ORANGE	2800	(063) 913 562	(063) 913 563
Mrs	PETERSON	Marina	Defence - Army	Environmental Officer	P.A.S.C.	Liverpool Mltry Area	2174	(02) 600 4723	(02) 600 4648
Cr	PHILLIPS	Winston	Cooma-Monaro Shire	Councillor	PO Box 714	COOMA	2630	(064) 501 777	(064) 501 799

Mr	PINES	Ken	Natl Parks & Wildlife Service	Pest Management Officer	PO Box 402	ARMIDALE	2350	(067) 737 129	(067) 711 894
Mr	PITT	Darren	Natl Parks & Wildlife Service	Pest Control Officer	PO Box 72	NARRABRI	2390	(067) 924 724	(067) 921 133
Mr	POMERY	David	Illawarra Dist (Nox) Weeds Auth.	Chief Weeds Officer	PO Box 148	KIAMA	2533	(042) 331 129	
Mr	POPOVIC	Peter	NSW Agriculture	Nox. Plants Adv. Offcr	PMB	GRAFTON	2460	(066) 420 449	(066) 447 251
Mr	PORTBURY	Geoff	Jerilderie Shire Council	Noxious Weeds Inspector	PO Box 96	JERILDERIE	2716	(058) 861 200	(058) 861 701
Dr	Powell	Jocelyn	HNCM Trust	Trustee Dir Res & Info	PO Box 556	WINDSOR	2756	(045) 774 243	(045) 774 236
Mr	PROCTOR	Peter	NSW Agriculture	Bio Weeds Unit	PO Box 174	MUDGEE	2850	(063) 721 969	(063) 726 870
Mr	QUINN	Jim	NSW Agriculture	Supervisor	PO Box 581	GOSFORD	2250	(043) 481 900	(043) 481 910
Mrs	RAWLING	Judie	Nox. Weeds Adv. Comm.	Managing Director (UBM)	PO Box 62	ROSEVILLE	2069	(02) 413 4722	(02) 413 4156
Mr	REEC	Bryson	Wellington Council	Weeds Inspector	PO Box 62	WELLINGTON	2820	(068) 452 099	(068) 453 354
Ms	REES	Lynn	Natl Parks & Wildlife Service	Bush Regen. Co-Ordinator	Lady Game Dr	CHATSWOOD	2067	(02) 412 1811	(02) 411 6034
Mr	RICHARDS	David	Gunnedah Shire Council	Chief Weeds Officer	PO Box 63	GUNNEDAH	2380	(067) 420 422	(067) 420 523
Mr	RICHARDSON	Noel	Gundagai Shire Council	Councillor	Sheridan St	GUNDAGAI	2722	(069) 441 266	(069) 441 475
Cr	RIDLEY	Suzanne	Yarrowlumla Council	Councillor	PO Box 112	QUEANBEYAN	2620	(06) 236 9251	
Mr	RILEY	Geoffrey	Merriwa Shire Council	Weeds Officer	PO Box 111	MERRIWA	2329	(065) 482 109	(065) 482 340
Mr	ROBERTS	Ken	Bombala Council	Noxious Plants Inspector	PO Box 105	BOMBALA	2632	(064) 583 555	(064) 583 777
Mr	ROBERTS	Ron	New England Tblnds C.C.	District Weeds Officer	PO Box 881	ARMIDALE	2350	(067) 711 700	(067) 711 893
Mr	ROBERTSON	Steve	Carrathool Shire Council	Snr Nox Weeds Officer	PO Box 12	GOOLGOWI	2652	(069) 651 306	(069) 651 379
Mr	RODWAY	Steve	Corowa Shire Council	Snr Nox Weeds Inspector	PO Box 77	COROWA	2646	(060) 331 277	(060) 333 317
Mr	ROGERS	Dick	Sutherland Shire Council	Bushcare Officer	PO Box 17	SUTHERLAND	2232	(02) 710 0192	(02) 710 0594
Mr	ROLLINSON	Don	Cabonne Council	Senior Weeds Officer	PO Box 17	MOLONG	2866	(063) 668 303	(063) 668 799
Mr	ROSSINGTON	Neil	Tenterfield Shire Council	Nox Weeds Officer	PO Box 214	TENTERFIELD	2372	(067) 361 744	(067) 362 669
Mr	ROTHE	Robin	Moree Plains Shire Council	Executive Manager	PO Box 420	MOREE	2400	(067) 529 533	(067) 522 425
Mr	RUSBY	Michael	Broken Hill City Council	Assist Mgr Parks & Reserves	PO Box 448	BROKEN HILL	2880	(080) 889 220	(080) 878 740
Mr	RUSSELL	Chris	Cobbett P/L	Technical Officer	PO Box 240	HORNSBY	2077	(02) 477 7944	(02) 477 7363
Mr	RUSSELL	Barry	Shoalhaven City Council	Manager Eng Wks	PO Box 42	NOWRA	2541	(044) 293 111	
Mr	RUTLEDGE	John	New England Tblnds C.C.	General Manager	PO Box 881	ARMIDALE	2350	(067) 711 700	(067) 711 893
Mr	RYAN	Paul	Cooma-Monaro Shire	Weeds Officer	PO Box 714	COOMA	2630	(064) 501 777	(064) 501 799
Mr	RYAN	John	Forbes Shire Council	Noxious Plant Inspector	PO Box 333	FORBES	2871	(068) 521 822	(068) 524 170
Mr	RYAN	Bruce	Pacific Power	Land Management Officer	Wang Pwr Stn	WALLERAWANG	2845	(063) 528 641	(063) 528 740
Mr	RYAN	John	Yarrowlumla Council	Noxious Plants Inspector	PO Box 112	QUEANBEYAN	2620	(06) 297 6113	(06) 297 5854
Mr	SAINTY	Geoff	Sainty & Associates		PO Box 1219	POTTS POINT	2011	(02) 332 2661	(02) 331 5372
Mr	SAMPSON	Barry	NSW Agriculture	Weeds Bio Unit	PMB	YANCO	2703	(069) 530 219	(069) 530 200
Mr	SAMUELS	Wal	Wellington Council	Chief Weeds Officer	PO Box 62	WELLINGTON	2820	(068) 452 099	(068) 453 354
Ms	SARGENT	Melinda	NSW Agriculture	District Agronomist	PO Box 141	KEMPSEY	2440	(065) 626 244	(065) 625 614
Mr	SCHMITZER	Terry	Hastings Council	Weeds Officer	PO Box 84	PORT MACQUARIE	2444	(065) 832 099	(065) 842 445
Mr	SCHWEITZER	Peter	Far North Coast County Council	Inspector	PO Box 238	CASINO	2470	(066) 841 983	
Mr	SCOTT	Bruce	Far North Coast County Council	General Manager	PO Box 238	CASINO	2470	(066) 622 396	(066) 625 511
Mr	SHANAHAN	Geoff	Upper Macquarie County Council	Nox Weeds Insp	PO Box 703	BATHURST	2795	(063) 314 200	(063) 312 121
Mr	SHARP	Malcolm	Orange City Council	Weeds Inspector	PO Box 35	ORANGE	2800	(063) 615 111	(063) 615 199
Cr	SHAW	John	Gunning Shire Council	Councillor	PO Box 32	GUNNING	2581	(048) 451 304	

Mr	SHEARGOLD	Wayne	Parkes Shire Council	Noxious Weed Officer	PO Box 337	PARKES	2870	(068) 628 333	
Cr	SHORE	Les	Nox Weeds Adv Comm	Member	56 Cattai Rg Rd	GLENORIE	2157	(02) 652 1428	(02) 652 1887
Mr	SILVESTER	Stephen	Cobbett P/L	Sales & Marketing Mgr	PO Box 240	HORNSBY	2077	(02) 477 7944	(02) 477 7363
Mr	SIMS	Ray	Junee Shire Council	Nox. Weeds & Environ. Offcr	PO Box 93	JUNEE	2663	(069) 241 277	(069) 242 497
Mr	SINGLETON	Ian	Hume Shire Council	Weeds Inspector	PO Box 70	ALBURY	2640	(060) 213 177	(060) 216 852
Ms	SKINNER	Lesley	NSW Agriculture	Legal Officer (Legislation)	L Bag 21	ORANGE	2800	(063) 913 550	(063) 913 563
Mr	SLY	Alan	Narromine Shire Council	Noxious Weed Inspector	PO Box 115	NARROMINE	2821	(068) 891 322	(068) 892 579
Mr	SMITH	Alan	Bega Valley Shire Council	Snr Nox Weeds Insp	PO Box 492	BEGA	2550	(064) 929 400	(064) 923 323
Mr	SMITH	Edward	Sthn Slopes Nox Plants Auth	Nox Plants Inspector	PO Box 3	BOOROWA	2586	(063) 853 189	(063) 853 562
Mr	SPONG	Joe	Wakool Shire Council	Noxious Weeds Inspector	PO Box 40	MOULAMEIN	2733	(058) 875 007	(058) 875 103
Mrs	SPOTSWOOD	Sonia	Goulburn City Council	Manager Environ. Services	PO Box 725	GOULBURN	2580	(048) 230 409	(048) 222 081
Mr	SPROULE	Bob	NSW Agriculture	Regl Dir Agric.	PO Box 389	GOULBURN	2580	(048) 230 624	(048) 230 630
Miss	STEINFURTH	Michelle	HNCMT	Resource Officer	PO Box 556	WINDSOR	2756	(045) 774 243	(045) 774 236
Cr	STEWART	Leigh	Snowy River Council	Councillor	2 Myack St	BERRIDALE	2628	(064) 563 251	(064) 563 117
Cr	STEWART	Leigh	Snowy River Council	Councillor	2 Myack St	BERRIDALE	2628	(064) 563 251	(064) 563 117
Mr	STIEGER	Doug	North West Weeds	Noxious Plants Inspector	PO Box 93	WARIALDA	2402	(067) 291 016	(067) 291 400
Cr	STOCKHAM	C	Castlereagh Macq C Council	Chairman	PO Box 31	WALGETT	2832	(068) 281 399	
Mr	STORM	Shane	Wakool Shire Council	Ganger	PO Box 40	MOULAMEIN	2733	(058) 875 007	(058) 875 103
Mr	STORRIE	Andrew	NSW Agriculture	Weeds Agronomist	RMB 994	TAMWORTH	2340	(067) 631 174	(067) 631 222
Mrs	STUBBS	Val	Mid Western County Council	Secretary	PO Box 138	MUDGEE	2850	(063) 72 1300	(063) 726 348
Mr	SULLIVAN	Paul	NSW Agriculture	Tech. Offcr (Sc)	RMB 944	TAMWORTH	2340	(067) 631 175	(067) 631 222
Mr	TANNER	Les	NSW Agriculture	Snr Insp (Weeds)	Locked Bag 21	ORANGE	2800	(063) 913 153	(063) 913 605
Mr	TAYLOR	Frank	Cropcare	NSW Development Manager	PO Box 182	WAGGA WAGGA	2650	(069) 223 098	(069) 262 834
Mr	TERRETT	Peter	Global Star		PO Box 222	FOREST HILL	3131	(03) 9894 2600	(03) 9849 2591
Mr	THERIAULT	David	DowElanco	Product Marketing Manager	L Bag 502	FRENCHS FOREST	2086	(02) 975 0159	(02) 975 0242
Mr	THOMAS	Jeff	Natl Parks & Wildlife Service	Project Officer	PO Box 361	GRAFTON	2460	(066) 420 613	(066) 420 671
Mr	THURLING	Robert	Wagga Wagga City Council	Chief Noxious Weeds Officer	PO Box 20	WAGGA WAGGA	2650	(069) 235 257	(069) 235 396
Mr	TICKNER	Graham	Gundagai Shire Council	General Manager	Sheridan St	GUNDAGAI	2722	(069) 441 266	(069) 441 475
Mr	TINK	Gordon	DowElance	Field Salesman	PO Box 1354	ORANGE	2800	(063) 652 223	
Mr	TOTH	John	NSW Agriculture	Research Agronomist	PMB 10	RYDALMERE	2116	(02) 683 9777	(02) 630 4475
Mr	TOWNSEND	Norm	Cabonne Council	Chief Weeds Officer	PO Box 17	MOLONG	2866	(063) 668 303	(063) 668 799
Mr	TROUNCE	Bob	NSW Agriculture	Weeds Agronomist	Locked Bag 21	ORANGE	2800	(063) 913 156	(063) 913 605
Mr	TULL	Mark	Gloucester Shire Council	Weeds Inspector	PO Box 11	GLOUCESTER	2422	(065) 581 601	(065) 582 343
Mr	TURTON	Craig	Snowy River Shire Council	Weeds Officer	2 Myack St	BERRIDALE	2628	(064) 563 251	(064) 563 117
Mr	TYE	Ian	Maclean Shire Council	Chief Nox. Weeds Inspector	PO Box 171	MACLEAN	2463	(066) 452 555	(066) 454 017
Mr	VANDERVELDE	Tom	North West Weeds	Noxious Plants Inspector	PO Box 93	WARIALDA	2402	(067) 291 016	(067) 291 400
Mrs	WALLACE	Jackie	Wollondilly Shire Council	Clerical Support	PO Box 21	PICTON	2571	(046) 771 326	(046) 772 339
Mr	WALLER	Rob	Far North Coast County Council	Inspector	PO Box 238	CASINO	2470	(066) 841 584	(066) 625 511
Mr	WALMSLEY	Pat	Sthn Slopes Nox Plants Auth	Nox Plants Inspector	PO Box 3	BOOROWA	2586	(063) 853 189	(063) 853 562
Mr	WARTON	Gary	Council of Camden	Senior Engineering Assistant	PO Box 183	CAMDEN	2571	(046) 552 455	(046) 552 770
Cr	WASS	David	Castlereagh Macq C Council	Chairman	PO Box 31	WALGETT	2832	(068) 281 399	

Mr	WATERS	Kevin	New England Tblnds C.C.	Mgr Noxious Weed Control	PO Box 881	ARMIDALE	2350	(067) 711 700	(067) 711 893
Mr	WATSON	Martin	Dow Elanco	Field Sales	PO Box 1000	WAGGA WAGGA	2650	(069) 219 408	(069) 219 544
Cr	WEARNE	John	Shires Association of NSW	President	GPO Box 7003	SYDNEY	2001	(02) 299 7711	(02) 262 1049
Dr	WESTERINK	Jan	Aust. Grad Schl Police Mgmt	Consultant Lecturer	PO Box 168	MANLY	2095	(02) 977 5800	
Mr	WIELAND	Lyndon	Wellington Council	Weeds Inspector	PO Box 62	WELLINGTON	2820	(068) 452 099	(068) 453 354
Mr	WILLIAMS	David	Cessnock City Council	Weed Control Officer	PO Box 152	CESSNOCK	2325	(049) 910 336	(049) 902 324
Mr	WILSON	Carl	Agriculture L/Care	Pest Control	PO Box 1038	TUGGERANONG	2901	(06) 207 2276	(06) 207 2268
Mr	WILSON	Ian	North West Weeds	Chief Weeds Officer	PO Box 93	WARIALDA	2402	(067) 291 016	(067) 291 400
Dr	WILSON	Bruce	QLD Department of Lands	Manager Development	L Bag 40	COOPAROO DEL CTR	4151	(07) 3406 2873	(07) 3406 2875
Mr	WOODS	Kevin	Carrathool Shire Council	Snr Nox Weeds Officer	PO Box 12	GOOLGOWI	2652	(069) 651 306	(069) 651 379
Mr	WOODS	Len	Nox. Weeds Adv. Comm.	Shires Assoc	Kylee	NIANGALA	2354	(067) 692 251	(067) 692 237
Mr	WOODS	Neville	Sthn Slopes Nox Plants Auth	Nox Plants Inspector	PO Box 3	BOOROWA	2586	(063) 853 189	(063) 853 562
Mr	WOODS	Errol	Ulmarra Shire Council	Weeds Inspector	PO Box 13	ULMARRA	2462	(066) 445 303	(066) 445 366
Mr	WORBOYS	Graeme	O'Malleys IAMA	Customer Services Co-Ord	PO Box 504	COOTAMUNDRA	2590	(069) 401 404	(069) 424 011