WEED MANAGEMENT TECHNOLOGY ON PUBLIC LANDS AND FORESTS

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INTRODUCTION

Unlike weeds in a cropping situation, environmental weeds on public lands occur in a wide variety of sites. In many of these sites access is difficult and weeds are intermixed with numerous unrelated and related non-target plants. The weeds themselves are also a complex mixture of species of varying life forms. Control of access to the land during weed control is often difficult and interest in these activities is high in urban and near urban areas. The same factors apply in natural forest situations. However, the weeds in plantation forests are more like crop weeds except that the major weeds are woody perennials rather than herbaceous species. This distinction has been recognised previously in most Weed Conferences and these weeds should continue to be considered as a special section of crop weeds.

A further important issue is the wide range of controllers of weeds on public lands, a diversity that is integral to this review. Controllers range from the Federal Government (National Level), through State based conservation bodies (Regional Level) to Local Government Bodies (Local Level), all using contractors, permanent staff and volunteers. The volunteers (Local Level) themselves may be private holders of bushland, or responsible to the Government bodies, or to independent volunteer or friends groups.

This diversity requires technology in its full sense, that is 'the total knowledge and skills available to any human society for industry, art or science' to be available for the successful control of environmental weeds. The issues needing to be considered are then:

- identification and prioritization of actual and potential weeds,
- best methods of control (biological, chemical or mechanical) for the situation and weed,
- education on the problems and impacts posed by environmental weeds to ensure resources are available to combat them, and
- best practises for natural area management to limit the invasion and impact of weeds.

This review will consider the issues raised above in light of a series of questions. That is, 'How have the past weed conferences addressed the technical needs at these levels?' 'How can they be addressed in the future?' 'Should these issues be addressed at Australian Weed Conferences?'.

WEED MANAGEMENT AT THE NATIONAL LEVEL

Potential weeds (education) To successfully control weeds at the national and regional level one needs to be able to prioritize the weeds needing to be controlled, since funding and manpower are always constrained. Also, there is a need to contain or eradicate those weeds identified as having a high potential to become widespread and serious threats to native vegetation.

With the national weed strategy (Smith *et al.* 1993) and the developing national approaches to listing major environmental weeds (Humphries *et al.* 1991), the first issue of setting priorities has been at least partly achieved by these reports and the promised commitment to adopt them. The second and ongoing need is to identify potential weeds. Early warning about potential serious weeds is a continuing and expanding feature of Australian Weed Conferences. This area first became a major conference feature in 1990 with the session on weeds in national parks and the paper on *Polygala* species in South Australia (Carter *et al.* 1990). While there were more general papers on this topic in preceding years, such as those by on ornamentals by Mulvany (1987) and water weeds by Jacobs and Sainty (1987) in the 1987 conference, these were not a significant feature in these conferences. Continuing the trend established in 1990, the 1993 conference saw a major increase in papers detailing the threat of specific environmental weeds. These papers alerted people to the potential for pond apple, *Annona glabra* (Swarbrick 1993a), *Hydrocotyle rannunculoides* (Dean and Ruiz-Avila 1993), *Ludwigia peruviana* (Jacobs *et al.* 1993), boxthorn, *Lycium ferocissimum* (Erkelenz 1993) and broomrapes, *Orobanche* species (Carter 1993). The paper on *Kochia scoparia* (Dodd and Moore 1993) could prove a model for forewarning and rapid eradication of a potential weed before it spreads out of control.

Control technology Australia is the only continent that is also a country and control of current widespread serious weeds at the national level involves assistance in the preparation of biological control agents for these target weeds. This has been a major section in Australian Weed Conferences since 1981. However, again, environmental weeds have only become an integral part of this session in recent times. In 1984 seven papers were presented, none of which dealt with environmental weeds; in 1987 seven papers were presented, with one on the pasture and

environmental weed, sensitive plant (*Mimosa invisa*); in 1990 thirty papers were presented, including seven papers on environmental weeds and in 1993 sixteen papers were presented with eight dealing with environmental weeds. There has been an increasing emphasis on environmental weeds since 1990, but most of the weeds considered are still predominantly agricultural weeds or are both crop/pasture and environmental weeds. This is not surprising as biological control programs are long term and control programs for environmental weeds are still very much in the development phase.

Past Australian Weed Conference papers have dealt with biological control issues associated with a series of major environmental weeds including bitou bush (*Chrysanthemoides monilfera* ssp. *rotundata*), boneseed (*Chrysanthemoides monilfera* ssp. *monilifera*), mimosa (*Mimosa invisa* and *M. pigra*), salvinnia (*Salvinnia molesta*), bridal creeper (*Asparagus asparagoides*), blackberries (*Rubus* species), prickly pear (*Opuntia* species), lantana (*Lantana camara*) and prickly acacia (*Acacia nilotica*). Australian Weed Conferences are one of the few avenues that many regional and local land managers have to be appraised of the current state of biological control programs for these continental scale weeds. It is essential that the current level of information on such programs continue to be presented at conference as the three year interval allows new results to accumulate for presentation at conferences.

WEED MANAGEMENT AT THE REGIONAL (STATE) LEVEL

Potential weeds (education) While specific cases of potential new weeds are becoming a feature of conferences and hence well reported there are few local or habitat based listings such as those by Swarbrick (1993b) on rainforest weeds, Keighery (1993) on southern Western Australian island weeds and Thompson (1993) on southern Queensland national parks. While weeds are introduced non-randomly into similar habitats and climates, and Australia shares many climates and habitats across the country, this is an area that could and should be developed. Land managers can then view what is happening across Australia in similar habitats through reviews of threatening weeds of widespread habitats such as coastal areas, creek lines, granite rocks and offshore islands. The sharing of this information through papers and direct interaction with those attending the conferences can alert local managers to potential and developing weed problems within their own regions.

The poster sessions at the Australian Weed Conferences are an ideal opportunity to highlight potential weeds. The poster on *Bamboo* species (Holsinger 1993) is such an example. Encouragement should be given to conference host States to focus on reviewing weeds threatening major habitats in their State. This gives a wider audience for what could be a national rather than local problem. Currently much of this information is found in the 'grey' literature of internal reports or limited release workshop proceedings.

There are too few case studies of the kind presented by Fuller (1993) on *Tamarix aphylla*, which reviews the history, invasion and control of an invasive weed. Encouragement needs to be given for case studies that review specific weeds, this would enable access to the 'grey' literature that pervades weed control efforts. Australian Weed Conferences have provided a vital means of altering managers to new and potentially serious weeds. This aspect needs to be continued and encouraged.

Control technology (herbicides/spray technology) Control technology has always been a major feature of conferences. Again there has been a slowly increasing emphasis on environmental weeds. In 1984 there were sixty eight papers on this topic with two on environmental weeds; in 1987 fifty six papers with six dealing with environmental weeds; in 1990 sixty five with four on environmental weeds and in 1993 seventy four papers with seven dealing with environmental weeds. In most of these papers there is much useful information on control of environmental weeds by herbicides, but these are largely as a by-product of studies on those are also crop weeds. Such an example is the report on Fusilade (Seth and Fua 1984) which has proved a very effective tool to control perennial veldt grass (*Ehrharta calycina*) in Western Australia. This is not surprising as the costs of developing new herbicides largely limit their initial selection to major crop weeds. The use of these herbicides on other species often follows, as in the case of Fusilade, and these studies are only occasionally reported at conferences.

This has led to considerable duplication in herbicide studies on controlling environmental weeds, which has repercussions for the detail, rigour and comparability of the studies. Studies on herbicide control of environmental weeds are generally minimally resourced, small scale, and local in nature. If and when these studies are compiled they are usually interim, internal or limited release reports that become part of the 'grey' literature.

In recognition of this problem specific workshops for the widespread and major environmental weeds are now addressing this issue. The workshop proceedings have been published formally, either as special issues of Plant Protection Quarterly (workshops on rubber vine, *Watsonia* species and bridal creeper) or as widely distributed workshop proceedings (*Spartina* species, Rash *et al.* 1996). However, there remains a very large number

of less spectacular weeds that are significant local and regional problems. Several examples have been presented at conferences for weeds that are problems across Australia as well as in the areas they were controlled, such as *Agave* species (Foley and Bolton 1990) and giant reed, *Arundo donax* (McLennan 1993).

The widespread dissemination of the results of herbicide trials for the successful control of a wide range of environmental weeds is a key role for future Australian Weed Conferences. There is a similar role for disseminating information on new equipment to distribute herbicides.

BEST MANAGEMENT PRACTICES TO LIMIT WEED INVASION AND IMPACT

With management of remnant bushland to limit weed invasion being the biggest issue confronting land managers today, the linking of the ecology of natural areas and the biology of native and naturalized species is vital. Generally this has been considered as predominantly an ecological discipline rather than an issue for the weed scientist. However, the understanding of such issues is essential for limiting the nature and impact of weeds on natural areas. There were three general papers on this topic in the 1993 conference.

There is some peripheral information on the above linkage contained in studies on the biology and ecology of weeds, but these seem to be generally declining. Again, if papers from past conferences are considered, there were twelve papers presented in 1984, fourteen in 1987, twelve in 1990 and ten in 1993, but only four of these forty eight papers related to environmental weeds. There is an obvious need to expand studies on the biology of environmental weeds, such as that being undertaken on bridal creeper by Kelly Raymond (personal communication), and for papers reporting these studies to again become a feature of conferences.

WEED MANAGEMENT AT THE LOCAL LEVEL

This is the area least well served by Australian Weeds Conferences. There are several reasons related to the very nature of weed control at the local level that are responsible for this.

Local groups need access to illustrated field guides to identify their environmental weeds and detailed information on hands-on control methods. Most volunteer and friends groups are reluctant to use herbicides and favour mechanical means as advocated by the Bradley method to control weeds. They have limited access to specialist literature and rely on those of us involved at both levels to allow them secondary access to these papers.

Identification of weeds, in the form of field guides is clearly beyond the scope of conferences, and many States now have regional listings and field guides (Carr and Jugovic 1992, Keighery 1995, Smith 1995). Conferences are best suited, at present, to present listings of what weeds threaten specific habitats and case studies of actual and potential specific weeds (as outlined previously). This is not a failing of the conferences since Australian Weed Conferences have had a major, though often indirect, influence on raising the profile of environmental weeds throughout Australia by bringing together interested parties to discuss and publish their findings. These findings are then hopefully translated to the cutting edge of weed management, those involved in the physical process of doing it. That is, it is essential that those of us involved at both levels share information relevant to local control.

CONCLUSIONS

Control of environmental weeds on public lands involves three major groups, staff members of conservation organizations at both State and Federal, local government officers and members of the public (friends groups and volunteers). All of these groups require technical information on the control of weeds. Past Australian Weed Conferences have had a major role in raising awareness of the need to define, study and control environmental weeds. This has now occurred and future conferences can be more focused on the identification of potential weeds, habitats threatened, methods and means of control of specific weeds and limiting the capacity of weeds to invade natural areas. A vital and continuing role of these conferences is to remove much of this information from the 'grey' literature and hence make it available to the wider community.

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