The Bird Observers Club of Victoria started pulling boneseed in 1958 and the Geelong Field Naturalists Club started in about 1965. These groups have concentrated on specific areas where they have conducted follow up revegetation. Unfortunately, initial revegetation was not with indigenous plants so a number of the planted native species have now become environmental weeds. The work of these two groups has been significant and their long term commitment to their projects is to be praised.

The Government has conducted chemical control programs for many years at great expense with little long term success. Since 1985, CNR has spent about $200 000 in chemical control of boneseed at the You Yangs. This included unsuccessful trials of aerial spraying of boneseed seedlings after the 1985 wildfire. An aesthetics program then followed which sprayed boneseed within a roughly 50 m buffer strip along the perimeter roads of the park. In hindsight, this chemical control program was doomed and control for aesthetic reasons was a waste of resources.

A biological control program for boneseed was established at the Keith Turnbull Research Institute in 1987. The first biological control agent, the black boneseed leaf beetle, was introduced into the You Yangs in 1990. The bitou tip moth was introduced to the You Yangs in August this year. The first agent has not had a big impact on the plants and it is too early to judge the success of the bitou tip moth.

The Friends group was informed of the biological control program when the program was established. Initially some members of the group were concerned that it was going to be another "cane toad". However, with education from the program leader, the group realized that it was the only hope the You Yangs had if it was integrated with other control techniques. Members of the group participated in the initial site investigations and took an interest in the program. The establishment of a display about the program in the park visitor centre has assisted in the promotion and understanding of the biological control work at the You Yangs.

A number of new biological control agents are being investigated and these look a lot more promising. It is a pity that the $200 000 spent on unsuccessful chemical control over the last eight years was not spent on research into biological control agents and integrated control techniques.

In summary, there is simply too much boneseed to remove by mechanical methods such as hand pulling. Chemical control has really made no impact due to access difficulties and rough terrain and the lack of follow up revegetation. The park area covered by boneseed is simply too large to treat by chemical methods alone. Biological control integrated with other control techniques and follow-up revegetation are our last chance. The Friends Group has high expectations for biological control but we realize we're in this for the long haul and biological control will only be successful if integrated with other techniques.

"The sun smiles down on the ancient hills as a slow day passes and a new day brings hope."

The role of the community in the implementation of biological control

S. Darby and **D.A. McLaren,** Department of Conservation and Natural Resources, Keith Turnbull Research Institute, PO Box 48, Frankston, Victoria 3199, Australia.

Summary

Community involvement in a number of biological control projects is discussed. Education is emphasized as a major factor required to make the community understand the capabilities and limitations of biological control and its implementation as part of integrated management plans for pests.

Introduction

Biological control is now being incorporated as part of a total management system for the control of pests in a wide range of situations. Weed infestations affect all members of the community, either directly or indirectly. They may cause increased commodity prices for agricultural produce by increasing costs of production, lowering yields or by contaminating produce. They may also have detrimental effects on the environment by choking out native vegetation, invading national parks and bushland and affecting the aesthetics of our landscape. They can also create problems through the over use of chemicals and the consequent contamination of soil and waterways.

Much time and money is currently devoted to addressing these problems, and increasing involvement can be seen through the formation of Landcare groups, ragwort action groups and school environmental awareness projects.

Biological control has specific but often limited use in the control of weed species. It is a long term approach useful in areas where other means of control are inappropriate, uneconomic or unachievable. The role of the community in the implementation of biological control is very important and an under utilized resource. The distribution and establishment of agents is essential to the success of a biological control program, but for the program to be wholly successful, the community needs to know of the use of biological control, understand it, believe in it, want to apply it and have the resources to use it (Andrews *et al.* 1992). It is through their participation and extension of ideas that community groups can work together to achieve the greatest success in biological control.

Education is critical in helping community groups to have realistic expectations concerning the speed and success of biological control. This would prevent some of the adverse effects on the establishment of biological control agents, such as site destruction through pressure to control or spray a weed. Greater understanding of the processes and long term nature of biological control would reduce these sorts of problems.

There are a number of ways that landholders currently support biological control. Many agricultural industries (e.g., Wool) pay a levy on sale of their produce that goes into research and development. Some of this money may then be allocated to research on biological control of weeds. On an individual basis, assistance is sometimes given by the provision of release sites, labour to protect sites (i.e., fencing), production of release cages to aid establishment or through use of local knowledge and observations. It is intended that future biological control projects will incorporate wider community involvement and that once a particular community group has had success with a biological control program, they can network with and help new or inexperienced participants. The Department of Conservation and Natural Resources supports community involvement and will provide up to date information that will assist in the implementation of biological control.

The rearing of biological control agents is an extremely costly and labour intensive process. If community groups can help with this rearing, more agents can be released and therefore establishment and spread of the agents will be enhanced.

Community involvement

Community control of bitou bush and boneseed (Chrysanthemoides monilifera)

Bitou bush and boneseed are invasive weeds, predominantly of coastal areas, which displace native flora and fauna. Dune care groups were formed to assist in the control of these weeds in eastern Australia. Over 75 groups are currently operating and are involved in various control measures. Some of these groups assist in the biological control of bitou bush by monitoring the release and establishment of agents under the guidance of officers from the NSW Department of Conservation and Land Management. They also collect and redistribute agents to enhance their spread and establishment. They are involved in chemical and physical control of bitou bush and the rehabilitation of the treated areas. It is a very successful program with interested, well trained and committed members (Holtcamp 1993).

Community control of Paterson's curse (*Echium plantagineum*)

Paterson's curse is a widespread noxious weed that was estimated in 1985 to cost agriculture in Victoria $3.2 million per year (Field *et al.* 1985). The Department of Conservation and Natural Resources (DCNR) along with the Department of Agriculture and the Victorian Farmers Federation, launched Operation Blue Hills in 1993, as an awareness and education program for Paterson's curse management. It provides a network of advice, information and assistance to landholders with Paterson's curse infestations, and is aimed at long term reduction and management of the weed. It is intended that Landcare groups from affected areas will liaise with DCNR area staff to formulate plans for the release of biological control agents to suitable areas over the next five to ten years. It is also hoped that community groups will become involved in mass rearing of biological control agents and in their subsequent collection and redistribution to other areas. This may also involve local schools who could assist in the breeding program and monitoring of sites. Assessment of success and spread of biological control agents is an integral part of the program and is necessary to enable future directions of research to be structured and planned.

Community control of European and English wasps (Vespula germanica and Vespula vulgaris)

European and English wasps are social insects that nest and feed in both urban and rural areas. They feed on sweet and proteinaceous foods and can interfere with human outdoor eating and living practices. They are also a problem to fruit growers, beekeepers and food processors. Wasp numbers within a nest can exceed 20 000 during summer and nest densities can be very high, up to 50 per km^2. In bushland areas, where they predate on native insects, they can decimate these populations and therefore affect insect, bird and animal populations dependent on this food source. They can also deplete nesting sites of native birds and animals. Wasps can sting repeatedly, especially if the nest is disturbed, and this can be fatal if the person or animal is allergic to the venom.

Biological control was initiated as part of a management strategy to address the growing wasp problem. Background information was obtained from councils regarding wasp species and densities. During summer many councils receive up to 1000 reports of nests from concerned residents and this provided an excellent means of locating nests required for mass rearing of the biological control agent, the parasitoid, *Sphecophaga vesparum*. Councils also located suitable release sites and provided a detailed history of infestations in the area. Releases involved more than 100 local councils from Victoria and Tasmania.

The rearing of the parasitoid was very labour intensive and required live nests for parasitoid breeding. The cost was partly funded by DCNR, and was subsidized by local councils to enable large scale breeding and release of the agents in problem areas. Workshops, talks and other educational information such as brochures and videos have been provided for use by councils, schools and interested industries. Workshops have enabled councils to monitor release sites and assess the progress of the program. Many councils have involved schools to assist them with this monitoring. This information will be used to assist in evaluating the success or failure of this program in future years. Importantly the dissemination of information by DCNR through the councils to the public via newspapers and other media, gives the opportunity for greater understanding of the problem. Knowledge of the life cycle of the wasp by the community enables early detection and treatment of nests, and the reduction in queen wasp numbers during their most vulnerable phase. As European wasps are not considered a problem in their countries of origin, ethnic groups from Europe have had to be informed of the serious potential of wasp infestations in Australia if nests are not controlled. These issues all assist in the control and reduction of spread of wasps.

Community control of ragwort (Senecio jacobaea)

In the USA, the community has been utilized very effectively in the collection and redistribution of biological control agents of ragwort. The Oregon Department of Agriculture (ODA) have coordinated the field collection and redistribution of the cinnabar moth *(Tyria jacobaeae)*, the ragwort flea beetle *(Longitarsus jacobaeae)* and the ragwort seed fly (*Botanophila seneciella).* An active redistribution program for the cinnabar moth did not begin until 13 years after its initial release. Nursery sites were established in each of the sixteen counties in Oregon and were then used as redistribution sites. By 1988, 3624 releases of cinnabar moths had been made (Brown 1990). Local landholders and their families were invited to these nursery sites as a social outing. The landholders were able to see the cinnabar moth caterpillars defoliating the plants and their children were supplied with boxes for their collection and subsequent release at their respective farms.

A similar program has been set up for redistribution of the ragwort flea beetle. The ODA rented three acres of land from a landholder in an area where the flea beetles had become well established. This land was planted with ragwort to grow flea beetles. The flea beetles were then harvested with a large vacuum cleaner and given out free of charge to local landholders (Dairy 1988).

In conjunction with active collection and redistribution of insects by ODA, a comprehensive public awareness program was developed. Information bulletins were made available to the public by ODA and the Oregon State University, emphasizing the identification of ragwort plants and the management methods for control. Training sessions were also established for plant and insect identification, site reporting, mapping of infestations, and collection and redistribution techniques (Brown 1990).

Biological control of ragwort in Victoria

Ragwort occupies more than 820 000 ha of the Strzelecki, Otway and Dandenong Ranges of Victoria (Lane *et al.* 1980). Approximately one million dollars is spent each year on ragwort control in Gippsland by the Department of Conservation and Natural Resources (K. King personal communication) and it is likely that dairy and beef producers would spend considerably more.

In Victoria, ragwort biological control agents have either failed to establish (cinnabar moth and ragwort seed fly) or have established intermittently and mostly in high altitude localities (ragwort flea beetles). However, greater success has recently occurred with the establishment of the ragwort crown boring moth, *Cochylis* *atricapitana.* This insect is increasing its populations and it should be possible to field harvest and redistribute it to other infestations, enhancing the spread of the moth. Some well established flea beetle sites are also being evaluated for field collection and redistribution with community involvement.

As *C. atricapitana* is easy to rear, an educational project on biological control of ragwort has been set up. School children from ragwort infested localities (Figure 1) have been invited to rear the ragwort leaf and crown boring moth, on potted ragwort plants in screened cages. The moths produced by the students are released at particular locations from where the students monitor their establishment and effects. Many of the students come from farms with ragwort infestations and this provides a practical biology project that students can relate to while also providing new release locations to help increase the spread of the biological control agents.

Companies and businesses were approached for sponsorship of the "Ragwort School Biological Control Project" and as a result, eighteen schools have received equipment enabling them to rear *C. atricapitana*. Each school has received screen cages, lights, a timer switch, research notes and been given introductory talks outlining the background and scope of the project. Teachers and students have been enthusiastic about the program as it gives the students practical information that they can use themselves or pass onto their family and friends. They learn that biological control takes a very long time to become effective and that it may not work in all situations. They also learn that biological control is only a part of broad range of management tools required to control weeds.

The ragwort school project is being expanded to include a project on biological control of blackberry. It is intended that school projects will be available on all our biological control projects in the future.

Other school biological control projects

There is also an excellent school biological control project initiated by the Department of Agriculture in Western Australia. It is called "BIOSCAN" and involves networking schools and landholders throughout south-western Australia. The students and farmers will work together on a series of field trials to determine the basic ecology of the various introduced and native dung beetles, and the bush fly, in Western Australia.

The New Zealand Department of Scientific and Industrial Research have produced an excellent school Kitset which has projects on all their current biological programs and has been readily adopted as part of the science and environmental science curriculum in New Zealand (Hayes 1991). This contains a number of project ideas, comprehension exercises and so on.

Biological control of weeds in New Zealand

A nationwide biological control of weeds extension programme has been underway in New Zealand since 1986. This has involved collaborating organizations (Regional Councils, the Department of Conservation, forestry companies and Landcorp Farming Ltd), to pay Landcare Research (Biological Control Group of Entomology, DSIR) for a service that includes supplying biological control agents, managing release sites, collecting data and training field staff. Noxious weed officers in Regional Councils have been trained to identify release sites, help collect and redistribute agents and to evaluate establishment of biological control agents. This has led to widespread establishment of control agents and the quick identification of localities where agents are unsuccessful. There has also been increased publicity about weed biological control programs which has raised its profile and understanding in the community (Syrett *et al.* 1993).

Conclusion

It is intended that community involvement in biological control projects will increase in the future, through techniques that community groups can use to mass rear agents or field collect and redistribute agents from established release sites. It is hoped to set up a system where landholders, community groups or educators will approach DCNR Pest Plant and Animal Officers in their area, to become involved in biological control programs for weed control. The DCNR areas will in turn plan and coordinate strategic releases of these agents in the field with the assistance of the Biological Control Unit (BCU) at KTRI. The BCU will then plan and mass rear agents according to all area plans and facilitate the delivery of

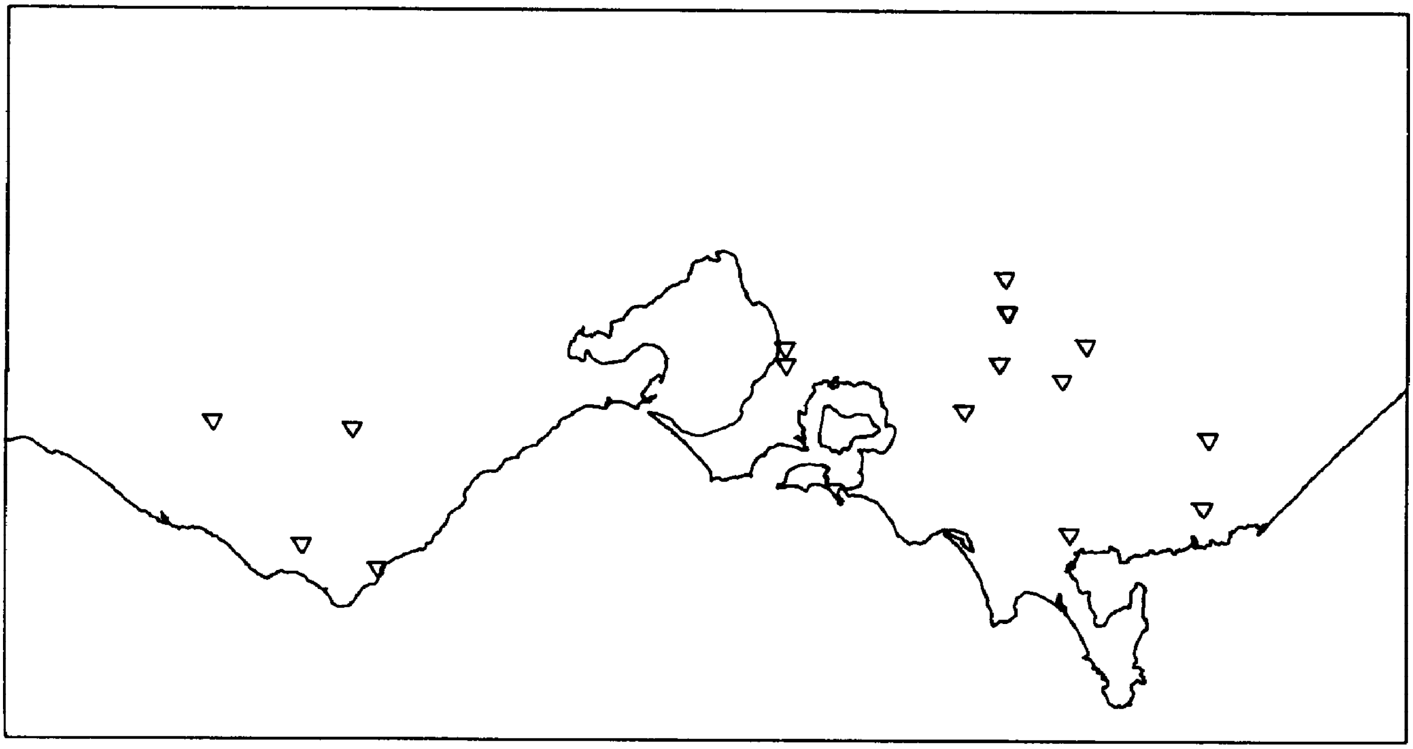

Figure 1. Schools involved in the ragwort biological control program.

these agents to the areas. The participants will thus gain a sound understanding of the principles of biological control of weeds and will learn the practical skills in managing release sites, monitoring and the collection and redistribution of agents in their area. If this process is well managed, the spread of agents will be faster than if they were left to spread naturally, allowing a greater chance to control weeds in selected and targeted areas that might otherwise not be controlled.

It is imperative that we educate our client groups that biological control agents:

- may not be the appropriate control technique in all areas infested by the weed,
- are not always successful,
- may take many years, if not decades, before they become effective,
- may not work in all climatic or geographical situations,
- will never eradicate a weed, but may reduce its population to a more manageable level or may reduce its ability to invade new areas,
- may not be effective against all species, strains or races of a weed,
- is only part of an overall management strategy. Landholders must endeavour to rehabilitate land after weed control has been carried out. If biological control is successful and landholders do not revegetate the land, then the weed controlled by biological control may be replaced by another undesirable weed species.

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Biological control of environmental weeds

Robin Adair, Keith Turnbull Research Institute, PO Box 48, Frankston, Victoria 3199, Australia.

Abstract

Environmental weeds are alien plants that invade native vegetation. Of the 800 or so taxa listed as invasive in Australia, 584 are recorded from Victoria. A high proportion of taxa were deliberately introduced into Australia for ornamental, agricultural or amenity uses. While some environmental weeds are economically important in agricultural ecosystems and urban areas, most are confined to native vegetation where they can have a serious impact on biodiversity, aesthetic values and recreation activities. Taxa that have a broad ecological range, are difficult to control using conventional techniques, have long-distance dispersal capabilities, and produce high biomass levels present the most serious threat. Infestations of these species are subject to control campaigns using either hand-pulling, fire, herbicides or a combination of these, but such efforts are invariably restricted to small and accessible locations. Treatment of large areas with these techniques is either impractical or may result in unacceptable non-target damage. As a result, environmental weed infestations are often neglected or treated in a superficial manner, despite concern over their impact on conservation values.

Classical biological control techniques offers the only possibility for control for many environmental weeds. In native vegetation, target specificity, self-dispersal, persistent action and long-term cost effectiveness offer advantages over alternative control techniques. In Australia, classical biological control programs have commenced on 33 environmental weed genera, five of which were initiated for the protection of nature conservation values (*Chrysanthemoides monilifera, Cytisus scoparius, Mimosa pigra, Myrsiphyllum asparagoides, Protasparagus* spp.), while 27 were initiated primarily for the protection of agricultural ecosystems (*Acacia nilotica**, *Ageratina* spp*., *Ambrosia artemisiifolia, Baccharis halamifolia, Carduus* spp., *Cirsium vulgare, Chondrilla juncea, Cryptostegia grandiflora**, *Echium plantagineum, Emex* spp., *Eriocereus* spp., *Heliotropium europeaum, Hypericum androsaeum, H. perforatum**, *Lanatana camara**, *Marrubium vulgare**, *Onopordium acaulon, Opuntia* spp., *Parkinsonia aculeata**, *Parthenium hysterophorus, Prosopis* spp.*, *Rubus* spp.*, *Rumex* spp., *Silybum marianum, Senecio jacobaea, Sida* spp., *Ulex europaeus*) and waterways (*Eichhornia crassipes**, *Pistia stratiotes, Alternanthera philoxeroides*), but ten of these (marked *) are also serious environmental weeds.

Despite these programs, the increasing rate of decline of native vegetation caused by the invasion of environmental weeds continues to threaten the integrity and, in some instances, the existence of native plant and animal communities in Australia. If current expectations and standards of nature conservation in Australia are to be maintained, a far greater emphasis on the control of environmental weeds is required. Integrated control programs that incorporate classical biological control offer the best prospects for reducing the ecological impact of a range of environmental weeds. Selection criteria for future targets for biological control should be based on current and potential distribution, rate of spread, ecological impact, susceptibility to conventional control techniques and relationship with