Summary  Two programs have been set up to increase community awareness and involvement in the biological control of weeds in the Top End of the Northern Territory.

One focuses on the redistribution of the stem-boring moth, carmenta (Carmenta mimosa Eichlin & Passoa) against mimosa (Mimosa pigra L.). Nine community groups have attended workshops and field trips and four release sites have been established using a simple release method, which can be easily implemented in isolated communities. The other aims to educate school children about weed issues by having them rear and release a biocontrol agent. Nine schools involving 14 classes have reared and released two agents: the leaf-feeding moth macaria (Macaria pallidata Warren) against mimosa and calligrapha (Calligrapha pantherina Stål), the leaf-feeding beetle which has been successful against sida (Sida acuta Burm). Adult insects have been released at 44 sites.

Keywords  Biological control, redistribution, education, community involvement, community empowerment, mimosa, sida.

INTRODUCTION
The Northern Territory (NT) covers 1.3 million km², and has a population of 200,000. With so few people, everyone has a responsibility to look after this unique environment. The NT Government Weeds Branch has limited resources and therefore aims to encourage people to take responsibility for weeds on their own land and to educate them about all possible management options.

The general public’s understanding of biocontrol is limited; the very mention of the word usually provokes comments about cane toads. People do not always understand how biocontrol works or how it fits in with other weed control options. Importantly, people need to be taught that biocontrol is a long-term process that will not eradicate a weed.

Educating people about biocontrol is also one way of attracting attention to, and promoting weed management as a whole. Biocontrol is attractive because it is an easier and cheaper way for people to become involved in weed management when compared with most other control options.

The Biocontrol Section of the Weed Management Branch in the NT Department of Infrastructure Planning and Environment (DIPE) has started two community involvement programs. These aim to increase community understanding of weed issues, especially biocontrol. Equally importantly, they aim to increase the distribution and density of key agents with the help of the community.

This paper describes these community education and involvement programs funded by the CRC for Australian Weed Management and the Natural Heritage Trust.

COMMUNITY REDISTRIBUTION OF CARMENTA
The tropical American shrub mimosa (Mimosa pigra L.) has spread throughout the world’s tropical wetlands where it can form impenetrable, nearly monospecific thickets (Lonsdale et al. 1995). The weed now infests over 800 km² of wetlands in the Northern Territory (C. Yates pers. comm.) threatening biodiversity, impacting on pastoral and agricultural activities and Aboriginal culture. Mimosa infests land that is seasonally inundated, where access is difficult and a lack of resources to aerially spray means that biocontrol is sometimes the only control option.

The stem-boring moth carmenta (Carmenta mimosa Eichlin & Passoa) was first released against mimosa in 1989. It has since established and appears to be the most effective of the 13 agents released to date (Paynter and Flanagan 2002). Stems die above the point where larvae feed and in some cases this can kill entire plants. Where present, carmenta has reduced seed production by around 70% overall (Paynter and Flanagan 2002). A comprehensive survey of mimosa agents conducted between 1998 and 2000 indicates that while the distribution of carmenta is increasing, the rate of spread is relatively slow at 2 km y⁻¹ (Ostermeyer 2000).

The DIPE biocontrol group is still actively redistributing carmenta because of its impact and because it has not yet established across the distribution of the weed. The group however is currently involved in rearing and releasing three other biocontrol agents and lacks resources to effectively carry out the
A simple release technique for carmenta, requiring few resources has been developed and is being trialled. Community groups can easily use this technique.

**Aims of the program** This program was set up to educate land users affected by mimosa, in particular Aboriginal rangers and traditional owners, about biocontrol. It is estimated that 26% of current mimosa infestations are found on Aboriginal land (C. Yates pers. comm.). Unfortunately the capacity of many Aboriginal people to manage weeds is often low, due to a lack of resources and knowledge, and the large areas and low population of a considerable proportion of their land (Storrs et al. 1999). Mimosa, for example, has become such a problem in some areas that the funds are not available to control it using conventional methods. Key ranger groups have been identified with the assistance of the Northern Land Council’s Caring for Country Unit, and were approached to participate in the community redistribution program.

**How does the program work?** The program usually comprises a half-day workshop at the biocontrol laboratories in Darwin, a field trip and, where appropriate, establishment of a release site. Weeds Branch staff sometimes travel to the communities, incorporating the workshops into meetings or gatherings. Releases of other mimosa agents currently being reared are also carried out with the assistance of community members, giving the community a greater ownership of the whole program.

At the workshops, staff explain weed issues, introduce the concept of biocontrol and help people understand how biocontrol fits in to Integrated Weed Management (IWM). People are then given an overview of the mimosa project and shown around the laboratory to see the effects of biocontrol for themselves.

They are also shown the simple redistribution technique for carmenta, which uses cleaned 44 gallon drums. Holes are drilled into the sides about 20 cm from the base. Mimosa stems infested with carmenta larvae are collected from the field and placed upright in the drums. Water is poured into the drums to keep the stems alive until larvae complete their development. The top of the drum is covered with mesh to exclude predators while still allowing adult moths to escape. The drums are easy to set up and the equipment is readily available in communities.

Where possible, groups are taken to a mimosa infestation where carmenta and other agents are present. Importantly, this gives them first hand experience at identifying the agents and demonstrates the impact of these agents in the field. At the same time, stems containing carmenta larvae are harvested and used to set up a new release site where applicable. Redistribution sites are set up with groups only if their mimosa infestation is large enough for biocontrol; some infestations may be targeted for eradication.

An identikit, with clear pictures and information to help identify the two agents considered most effective, carmenta and neurostrota (Neurostrota gunniella Busck), has been produced and is given to workshop participants. The kit illustrates the damage the agents are capable of and also includes information about the two mimosa agents currently being reared and released.

**What has been achieved?** The program has been well received by Aboriginal communities. Since it commenced in late 2002, eight Aboriginal groups have been involved and four release sites, including a demonstration site, have been established (Figure 1). Ngatpuk Rangers from Wagait Aboriginal Land Trust have eagerly taken up the redistribution concept and plan to set up several release sites on their land.

As a result of the workshops, some community members have started to release agents. The Adjumarl-larl Traditional Owners from the Oenpelli region near Kakadu and people from the Wangamatty Landcare Council of the Daly River/Port Keats Land Trust have helped release agents. Instead of Weeds Branch staff travelling to remote areas, people take agents back to their land after visits to Darwin, or the insects are sent out to communities for release. The Weeds Branch is then provided with release site information.

To date the Biocontrol Section has mainly worked with traditional owners and Aboriginal Ranger groups, but the model will be extended to Landcare groups and pastoralists in key areas.

**WEED WARRIORS**

**Aims of the program** Another program, based on the Weed Warriors concept used in Victoria, aims to educate and increase community awareness about weeds and weed management, in particular biocontrol, by working through the primary schools. It is a way to educate the broader community, especially small rural block owners around Darwin, and at the same time increase the number of agents released in the field.

**How does the program work?** Students from primary schools in the rural areas around Darwin are the main focus, as they are more likely to encounter the weeds targeted for biocontrol.

The program runs for five weeks, with Weeds Branch staff initially giving a 60 minute presentation on why weeds are such a problem, weed control...
methods and specifically how biocontrol works. Students are also taught the biology of the insect and how to look after it. Each class is provided with a rearing cage, potted plants and eggs or egg laying adults. They are given an information pack containing posters and fact sheets, detailing the weed, the life cycle of the agent they are rearing and the agent’s impacts. Students then rear the insects through one generation in the classroom.

They are also given fact sheets on other important biocontrol agents for weeds of the Northern Territory. These materials were produced specifically for use in schools but have also been useful in displays for the general public.

Each school is revisited during the five-week period to check insect and plant health and to answer the many questions asked by the students. A final visit is organised where students collect newly emerged adults from the cages and release the insects onto a weed infestation.

What has been achieved? In late 2003, the students reared the latest mimosa agent, the leaf-feeding moth, macaria (*Macaria pallidata* Warren). Macaria is an ideal agent for students because the impact of larvae stripping the leaves is highly visible, and the moth is also relatively easy to rear. However, problems with the laboratory colony, the short life span of adults and the difficulty of accessing suitable mimosa release sites led to a change in focus. When the program was run in 2004, the brightly coloured sida beetle calligrapha (*Calligrapha pantherina* Stål), which has been very successful, was reared instead. Sida (*Sida acuta* Burm) is a common weed in the Darwin rural region.

The sida beetle is established across the Top End and is a very effective agent, however populations are limited by a lack of food in the dry season. Most sida dies off in the dry, however some plants near water survive. Recent long dry seasons have hindered the beetle’s survival at many sites and it has taken longer to build up to damaging levels in the wet season. Often sida has flowered and set seed before calligrapha populations begin to have an impact. It was felt that teaching students about the agent, emphasising how easy it is to redistribute, and having students release calligrapha at home, will not only increase its distribution but also help it survive the dry season.

Nine schools and 14 classes have participated to date. Five groups released moths onto two mimosa infestations and seven classes released beetles onto six infestations of sida. Thirty-six students released calligrapha onto sida infestations on their own rural properties. Teachers and students alike are enthusiastic and are keen to continue and expand on the concept. Information has gone beyond the classroom and to the broader community. Many students searched their local area for sida and calligrapha. Other students have taken their parents to a release site near a shopping complex and shown them how the beetles damage the weed. Another student has now established a population of calligrapha on his property in the rural area and is actively redistributing them to patches of...
sida on the properties of his friends and relatives. He also intends to keep a patch of sida alive over the dry season to maintain the population of insects.

Media releases have led to several newspaper articles and radio interviews, further raising the profile of biocontrol in the community. School newsletters have run feature stories about the projects.

Students from Adelaide River School have embraced the concept of biocontrol and weeds in general. This program, various articles in newsletters and the enthusiasm of the students has led to community empowerment. A meeting of the Coomalie Landcare Group in Adelaide River township was held recently, at which the community, including many parents, showed that they could also address weed issues with the same enthusiasm. A program has now been set up to eradicate mimosa from around the township and along the Adelaide River itself. The group has applied for a grant for continued funding.

DISCUSSION
Wherever possible the Weeds Branch is looking at ways to encourage community involvement, even if it is simply having groups release agents and provide relevant release information to staff. The Weed Warriors project may now be extended from the original one-off project to setting up on-going links with several schools. These schools would look after nursery sites, allowing calligrapha to survive the dry season, and providing a point from which the beetles can be easily redistributed early in the wet season. Weeds Branch staff are often called upon to provide beetles for landowners and if schools could provide the beetles it would allow staff to concentrate on other projects.

Biocontrol can be used to attract people’s attention to broader land management issues. The impact of calligrapha is obvious and rapid, and publicising the biocontrol of sida could raise the issue of land management and lead to a change in land management practices. Infestations of sida are often indicators of poor land management, such as overgrazing. Biocontrol of sida therefore addresses the symptoms rather than the cause, and other annual weeds such as hyptis (Hyptis sauveolens (L.) Poit) and sicklepod (Senna obtusifolia (L.) Irwin and Barneby) often replace sida after successful biocontrol. There is potential for a project using biocontrol to reinforce the importance of good weed and land management practices to landholders.

The two programs described in this paper have helped educate and empower communities to tackle weeds on their land. They have also publicised biocontrol and other weed issues. Just as importantly, these programs have also helped to increase the distribution of key agents.

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REFERENCES

