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## Managing Weeds in a Changing Climate

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## Biocontrol of weeds in the Northern Territory: what has it achieved?

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**Summary** This paper discusses and summarises results of biocontrol projects in the Northern Territory (NT). Biocontrol has been a large component of weed management in the NT, as it is often the only feasible option for managing weeds that are spread across very large areas. We discuss what biocontrol has achieved against nine weeds that have been targets for biocontrol in the NT. These results have not been compiled previously for the NT specifically. Biocontrol has been a big success against mimosa (*Mimosa pigra* L.), salvinia (*Salvinia molesta* D.S.Mitchell) and sida (*Sida acuta* Burman f.). Biocontrol has had little or no effect on other NT weeds, justifying the need to continue searching for and releasing agents.

**Keywords** *Mimosa pigra*, *Salvinia molesta*, *Sida acuta*, *Parkinsonia aculeata*, *Xanthium occidentale*, *Jatropha gossypifolia*.

### BIOCONTROL IN THE NT

Many weed infestations in the NT are suited to having biocontrol as a component of their management. Chemical and physical weed management methods are often impractical over the very large areas covered by many weeds, and control often costs more than the value of the land. Many of these weeds require at least three years of follow up control. Once a weed becomes firmly established over a large area, biocontrol often becomes the only affordable means of control. The advantages of biocontrol are the ability of successful agents to disperse independently and on-going management with limited long-term input regardless of the size and density of infestations. Several biocontrol projects in the NT, particularly mimosa, have a long history of funding, and are producing good weed control as a result (Table 1).

Biocontrol commenced in the NT in 1977, when a rust fungus against Noogoora burr (*Xanthium occidentale* Bertol.) was redistributed from Queensland. Searches for biocontrol agents against other weeds have been conducted by CSIRO Entomology on behalf of the NT Government since 1980. This paper discusses what has been achieved by biocontrol in the NT, and uses this information to outline future directions.

### MIMOSA

Mimosa spread rapidly across NT wetlands in the 1960s and 70s. It is one of the NT's worst weeds and has significant negative impacts on the pastoral industry, recreation and biodiversity.

The first biocontrol agents against mimosa were released in 1983. A total of 14 agents have been released, seven of which have established and several are causing conspicuous damage to mimosa (Routley and Wirf 2006). A root and seedling-feeding beetle (*Nesaecrepida infuscata* Schaeffer) is likely to be released once approval has been granted. Another agent is currently undergoing host specificity testing. *Neurostrotta gunniella* Busck, *Coelocephalopion pigrae* Kissinger and *Acanthoscelides puniceus* Johnson are established, and can now be found on most populations of mimosa.

The most damaging agent, *Carmenta mimosa* Eichlin and Passoa, is still increasing in abundance, indicating that impacts of biocontrol are likely to increase over time (Ostermeyer unpublished data). This insect helps to open the canopy, increasing grass cover, and competition for mimosa seedlings.

Monitoring of the mimosa biocontrol program has been well-funded and well-conducted. Data were collected on seedbank dynamics and seed dispersal, plant demography and biology, seedling mortality and litterfall. Recent measurements indicate that seed production and seedbanks are reduced by up to 90% (Paynter 2005, Routley and Wirf 2006).

### PARKINSONIA

*Parkinsonia (Parkinsonia aculeata* L.) is a woody weed that reduces pastoral and environmental values in tropical and subtropical savannas. Biocontrol of parkinsonia began in 1982. Three insects were released in the NT, but only the seed-feeder, *Penthobruchus germani* Pic., appears to have established. It is relatively abundant through much of the NT, but few seeds are predated, in part due to very high egg parasitism rates (van Klinken 2005, unpublished data). Native-range surveys to locate new potential agents have recommended (T. Heard pers. comm.).

**Table 1.** Summary of outcomes from biocontrol in the Northern Territory.

Weed	Status of program	Result of biocontrol in the NT
Mimosa	Well funded, ongoing.	Seed production decreased. Seedbanks decreased by 90%. Increased competition for seedlings. Impacts likely to increase over time.
Parkinsonia	Several agents released. Native-range surveys for additional agents recommenced in 2001.	Some decrease in seed production. New biocontrol agents warranted.
Salvinia	Redistribution of agent.	Chemical control now rarely necessary.
Sida	Redistribution of agent.	Substantially reduced chemical and mechanical control.
Noogoora burr	Terminated. Program never received significant funding from the NT.	Impacts currently being evaluated.
Bellyache bush	One insect released. Survey and host testing terminated prematurely due to funding constraints, but may continue with new sources of funding.	Agent not established after three years of rearing and releases.
Hyptis	Project terminated prematurely when NT priorities changed.	No agents released.
Mesquite	Project terminated as NT populations were targeted for eradication.	Limited or no impact.
Mexican poppy	Project terminated prematurely when NT priorities changed.	No agents released.

### SALVINIA

Throughout the late 1970s and early 80s, salvinia transformed a number of open waterways and important barramundi fisheries in the NT into large green mats with impeded water flow, limited boating and fishing opportunities and unpredictable dissolved oxygen levels.

Physical and chemical control eradicated salvinia from some areas, but were insufficient at other sites. Biological control of salvinia in the NT began in 1981 with the release of the weevil *Cyrtobagus salviniae* Calder and Sands at Nhulunbuy. This eliminated the need for aerial spraying and enabled many waterholes to be used by recreational fishers. Infestations in Kakadu National Park have been monitored, and interactions between salvinia, weevils and the environment studied (Storrs and Julien 1996). Currently, salvinia management in the NT involves redistributing the weevil to any new infestations.

An initiative funded by the Weed CRC will set up weevil-rearing tanks on two remote Aboriginal communities, enabling Traditional Owners to manage salvinia themselves.

### SIDA

Spinyhead sida colonises heavily grazed and disturbed areas such as roadsides, and is unpalatable to stock. Large stands of sida previously occurred throughout

grazing land in northern Australia and it was a nuisance in small rural blocks around Darwin. Biocontrol of sida commenced in 1985 and the leaf-feeding beetle *Calligrapha pantherina* Stål was released in 1989.

The beetle defoliates plants, reducing plant size, seed production and seedbanks (Lonsdale *et al.* 1995). A survey of land managers found reductions in the costs of herbicide and mechanical control since the introduction of the beetle, and some landholders considered that sida had been replaced by useful pasture species (Flanagan *et al.* 2000). Beetle numbers decline over the dry season, and redistribution is often required. Although it is not possible to measure economic impacts of the beetle from the survey, the fact that many landholders value the beetle, and will ensure its survival over the dry season, and the large number of requests that the NT Weeds Branch receives for shipments of this beetle suggests that the beetle has had a large impact on a highly visible problem weed.

### NOOGOORA BURR

Noogoora burr grows mainly on riverbanks and flood plains of some Top End and Kimberley rivers, where it can form dense stands that impede movement of people and stock, limiting access to water and fishing areas. The spiny burrs can cause skin and eye damage. It has also been implicated in stock poisoning (Hocking and Liddle 1995).

Biocontrol appears to be the only possible means of reducing large infestations in such inaccessible, crocodile-infested areas (van Klinken and Julien 2003). A rust fungus, *Puccinia xanthii* Schw., first appeared in Australia around 1975. The gall-forming moth *Epiblema strenuana* Walker was first introduced in 1982. Both agents have been released in the NT.

The rust has been much less effective in the NT and Kimberley than in eastern Australia (Hocking and Liddle 1995), as it has specific temperature and humidity requirements, which are unlikely to be adequately met in far northern Australia (Morin *et al.* 1996). Surveys on the Daly River in 2005, however, found 97% of plants were infected, with roughly 10% of leaf area infected.

The gall-forming moth is widespread in the NT. In a recent survey, it was found on 82% of plants on the Daly River and 27% of plants on the Victoria River, with a mean of 6.5 (s.e.m. = 0.5) galls per plant on the Daly River and 0.7 (s.e.m. = 0.1) on the Victoria River (Grace and van Klinken unpublished data). The impacts on the plant in the NT are unknown.

#### BELLYACHE BUSH

Bellyache bush (*Jatropha gossypifolia* L.) is an aggressive weed that forms dense thickets. It is toxic and competes with desirable pasture species. Current options for control of bellyache bush are very expensive. CSIRO, supported by funds from the NT and Queensland governments, began searches for biocontrol agents in 1997 (Heard *et al.* 2002).

The seed-feeding bug, *Agonosoma trilineatum* Fabricius, was first released in 2003. It is too early to predict the likely outcome of this agent, but if it survives, its impact on seed production may slow the spread of the weed, and to reduce the amount of expensive follow-up control required after stands have been controlled by other means.

#### OTHER WEEDS

Hyptis (*Hyptis suaveolens* (L.) Poit.) is present across much of northern Australia, where it can form dense thickets along roadsides and watercourses. It is unpalatable to stock and other animals, can cause allergic reactions and has considerable nuisance value. The biological control program against hyptis (Julien 2002) was terminated in 2002 as a result of changes in funding priorities in the NT Government. No insects were released.

Searches have been made for potential agents against Mexican poppy (*Argemone ochroleuca* Sweet). Again, funding constraints and a change in focus of the NT Government resulted in this project being terminated before any agents were properly tested. There are

doubts that this weed would cause sufficient impacts to warrant a biological control program.

Agents have been released against mesquite (*Prosopis pallida* (Willd.) Kunth) in the NT. However, they had little if any impact, (van Klinken *et al.* 2003) and the weed is now targeted for eradication from the NT.

#### OTHER OUTCOMES

In addition to impact on weeds mentioned above, the biocontrol program in the NT has produced other positive outcomes. Mimosa has been the focus of much quality research into plant biology, integrated management and biocontrol. Such research is only possible with adequate long-term funding. Biocontrol is also a good means of attracting interest of members of the public and landholders, e.g. Aboriginal Rangers redistributing agents (Ostermeyer *et al.* 2004). Weed Warriors programs in schools have produced considerable benefits, especially for weed awareness.

#### CONCLUSIONS AND FUTURE DIRECTIONS

Biocontrol has undoubtedly helped to manage some weeds in the NT, most noticeably salvinia, sida and mimosa. The NT Government did not contribute financially to searches for, or testing of, new agents against salvinia, so returns to the NT from the relatively cheap redistribution program are excellent.

Table 1 shows that several projects funded by the NT Government were terminated prematurely when priorities and funding changed, a problem that is certainly not confined to the NT (Fowler 2000).

Several grasses are threatening ecosystem function in NT savannas and wetlands. Two such species, *Penisetum polystachion* L. and *P. pedicellatum* L., are due to be nominated as targets for biocontrol shortly (Grace 2006). Other introduced grasses may not be suited to biocontrol, despite causing considerable environmental damage, as they have value to the pastoral industry (Grace *et al.* 2004). Other troublesome weeds in the NT, such as athel pine (*Tamarix aphylla* (L.) Karst.), alligator weed (*Alternanthera philoxeroides* (Mart.) Griseb.) and cabomba (*Cabomba caroliniana* Gray) are not suitable for biocontrol as they are targeted for eradication from the NT.

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