Managing mi

Entomologists have enlisted a battery of beetles to help loosen mimosa's grip on northern Australia.

Kate Smith reports.

Australia's tropical rangelands provide a home away from home for many exotic plant species, dozens of which have become established since European settlement.

The worst offender is *Mimosa pigra*, (also known as mimosa, giant sensitive plant or giant sensitive tree) a species introduced to the Darwin Botanic Gardens in the late 19th century. It is now one of Australia's worst environmental weeds.

In 1999, *Mimosa pigra* was declared by the National Weeds Strategy, (an initiative of the National Heritage Trust and Agriculture Fisheries Forestry Australia), as one of the 20 inaugural Weeds of National Significance (WONS).

Mimosa grows at an alarming rate, and infestations can double in size in just over a year in favourable conditions, such as following good rainfalls.

Last year mimosa infestations were discovered in two outlying locations, one at Legune Station on the Northern Territory/Western Australia border, and another in a dam near Proserpine in Queensland. The potential distribution of mimosa extends from Broome in WA to northern New South Wales.

Mimosa can completely alter the natural landscape. Impenetrable thickets overrun pastures, hinder mustering, prevent access to water, and threaten income from the tourist industry in areas such as Kakadu National Park (where it is already advancing) and other tropical wetlands.

Halting mimosa's advance

The native range of mimosa extends from Mexico to northern Argentina, where it is effectively controlled by more than 440 species of insects and a range of fungal pathogens.

In Australia, as with many other introduced invaders, there are no natural predators to keep mimosa in check, hence its rapid spread. And by the time mimosa

Far left: The Mexican beetle *Malacorhinus irregularis* is a well-established biocontrol agent. It eats leaves, roots, seedlings and seeds of mimosa at various life stages.

Centre left: Mimosa grows at an alarming rate, and infestations can double in size in just over a year in favourable conditions, such as following good rainfalls.

Left: Seed and flower feeders such as *Coelocephalapion pigrae* sometimes take time to establish large enough populations to keep up with the peaks in mimosa flower production.

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was declared a weed it had become too widespread and well established to be eradicated. Reducing the size of the infestation and limiting further spread is the most that can be expected.

CSIRO Entomology began its involvement in the management of rangeland weeds in 1979, with the establishment of the *Mimosa pigra* biocontrol project, a collaboration with the Northern Territory Government and the Northern Land Council.

Biological control

The first agents to be released were the seed-feeding beetle *Acanthoscelides puniceus* and *A. quadridentatus* in 1983. Since then, a further nine insects and two fungal pathogens have been released, with varying success.

Six of the insect species are well established and locally abundant. They are the flower-feeding weevil, *Coelocephalapion pigrae*, the stem-mining moth, *Neurostrota gunniella*, the stem-boring moth, *Carmenta mimosa*, the seed-feeding beetle, *Acanthoscelides puniceus*, the leaf-feeding beetle *Chlamisus mimosae* and the Mexican beetle *Malacorhinus irregularis* which eats leaves, roots, seedlings and seeds at various life stages.

Agents that feed on leaves and stems are able to attack mimosa all-year round.

Seed and flower feeders such as *A. puniceus, C. pigrae* sometimes take time to establish large enough populations to keep up with the peaks in mimosa flower production. This is due to the highly seasonal northern Australian climate. For much of the year, flowering and seed-set is at low levels, so populations of flower and seed-feeders are also low.

After the wet season, there is a burst of flower and seed production so sudden that flower and seed-feeding beetles do not seem capable of breeding fast enough to keep up.

International advances

MIMOSA is also a serious weed in other parts of the world (Thailand, Myanmar, Laos, Cambodia, Vietnam, Malaysia, Indonesia, India, Sri Lanka and Papua New Guinea).

It is widespread in Africa, but in most countries has not yet become a problem, although recent reports suggest its increasing presence in Ethiopia and Zambia.

An international symposium in Darwin addressed the state of play in mimosa management and developed a set of recommendations for further work, including increasing management activities at the international level. Proceedings from the symposium will be published in mid-2003.

Above and below: Mimosa can completely alter the natural landscape. Impenetrable thickets overrun pastures, hinder mustering, prevent access to water, and threaten income from the tourist industry in areas such as Kakadu National Park (where it is already advancing) and other tropical wetlands.

Two highly successful agents so far are *Neurostrota gunniella*, which mines green stem tips, and *Carmenta mimosa*, which bores into larger stems and trunks, and even reaches the roots in the dry season.

Ongoing evaluation of these insects has revealed a dramatic reduction in seed production, together with similar reductions in seed banks and seedling establishment.

Furthermore, larvae of the leaf-beetle, *Malacorhinus irregularis*, which was recently confirmed to have established in Australia, live in the soil where they destroy germinating seed and young seedlings. This agent, together with the other established agents, has the potential to virtually arrest seedling regeneration.

The latest agent, a leaf-feeding moth, *Macaria pallidata*, was released mid-2002. Several other insects may be released in the future, depending on the availability of resources to assess them.

They include another leaf beetle, *Syphrea bibiana*, two species of flower-feeding *Sibinia*, another moth, *Leuciris*, a tip weevil, *Pselaphorhynchites*, and a seed-feeding wasp, *Risbecoma pigrae*. Only agents that are host-specific and likely to be effective are selected.

Even with such successful agents, control will take time – mature established plants are resistant to attack by biological control agents and their impact only becomes apparent over generations as the number and vigour of mimosa plants reduces, and stands gradually thin out. But some landholders cannot wait that long, so other control methods are employed.

Fire and mechanical control

On its own, fire is usually an ineffective control method as mimosa is difficult to burn when it is healthy. Fire can also reduce competing vegetation and stimulate seed germination, allowing mimosa to establish from the seed bank.

Mechanical crushing can enhance the impact of fire, by promoting hotter fires that kill a higher proportion of mimosa seeds. Nonetheless, follow-up control is likely to be required for several years to prevent mimosa re-establishing while the native floodplain flora recovers.

Herbicide

Herbicides are applied in three ways: by spraying either aerially or from the ground; as a basal bark or cut stump

application; or applied for absorption by roots. Single applications of herbicide are rarely effective against mimosa, mainly due to regeneration from the seed bank.

Access can also be a problem. Much of the land overcome by this plant is floodplain and inaccessible for much of the year, and many infestations occur as an understorey in *Melaleuca* forest, where herbicide applications could cause non-target damage.

A combined approach

In 1997, an integrated control experiment began on a 128-hectare infestation at the Wagait Aboriginal Reserve (Finnis River catchment). The infestation is being treated with combinations of herbicides, bulldozing and burning, and biocontrol control agents already established in the area.

Monitoring of the site shows that the biocontrol agents have the largest impact on re-growth of mimosa after mechanical or herbicide treatment. This experiment is giving researchers some insights into future management strategies.

A costly invasion

A major factor in the battle against invasive weeds in this part of the Australia is cost: the economic return of the land compares poorly with the high cost of weed management.

An exception is Kakadu National Park. If Kakadu was to be overtaken by mimosa, losses to the NT Tourism industry would be enormous. Annual tourism revenue is put at more than $400 million from an average 200 000 visitors.

Of course, economic values are just one aspect of assessing the importance of protecting ecological integrity. Others include the value of biodiversity and loss of amenity (and economic values) for traditional land users.

More about mimosa

CSIRO Entomology tropical weeds management research website is at: www.ento.csiro.au / research / projects_2001-2002 / trop_weeds.html

National Weeds Strategy: www.weeds.org.au / index.html

Northern Territory Weeds Management Strategy 1996–2005: www.nt.gov.au / dbird / dpif / plants / weeds / manage_strategy.shtml.

More biocontrol battlefronts

Mesquite

In terms of area, mesquite (*Prosopis* sp.), a woody weed from Mexico with 10 cm thorns, is a more invasive pest than mimosa.

It has spread across thousands of kilometres of grazing land in northern Australia since its deliberate introduction as a shade tree and forage plant.

In 1998, two insects were released: a leaf-tying moth (*Evippe* sp. #1) and a sap-sucking psyllid (*Prosopidopsylla flava*) which causes dieback. The moth is breeding at most release sites, and is causing extensive damage at some sites. The psyllid has established at some sites in Queensland but is not yet having an impact.

Field work is continuing at the largest mesquite infestation in the Pilbara region of WA where the agents are having more success. Results from this research will be applicable to other infestations throughout Australia.

Parkinsonia

One of the least studied weeds in Australia is *Parkinsonia aculeata* (parkinsonia). This woody weed from Central America forms impenetrable thorny thickets.

In Australia most parkinsonia is in remote areas and sustainable management of this weed is not yet possible. Three biocontrol agents have been released, but with little or no impact so far. A network of study sites representing the climates and habitats in which parkinsonia grows is currently being set up across northern Australia.

Hyptis

Hyptis suaveolens (hyptis) is an unpalatable woody herb that forms thickets where natural vegetation has been disturbed, such as along roadsides, in overgrazed pastures and around high disturbance areas such as stockyard and old cultivations.

Initial studies on biocontrol for this weed started in the 1980s, but no suitable agents were found. Renewed surveys in Mexico and Venezuela found a range of insects for consideration.

The first of these, a *Coelocephalapion* sp., was imported into quarantine in Brisbane in November 2000, but testing revealed it was not sufficiently host-specific and it was eliminated as a biocontrol agent.

Several seed-feeding beetles were also imported into quarantine, but the insects that were collected from Venezuela failed to thrive on the Australian form of hyptis. Native range surveys for new potential agents continue.

Bellyache bush

Jatropha gossyiifolia (bellyache bush) is a serious weed in tropical Australia.

It is native to the Caribbean region and was introduced deliberately as an ornamental across many parts of the world.

The common name refers to the toxic properties of the seeds which are harmful if ingested. In fact this plant is responsible for the death of many grazing animals especially during drought, when little other forage is available.

Biocontrol work on bellyache bush started in 1997, with field surveys focusing on the drier islands of the Caribbean and the Venezuelan coastline.

Several species of beetle and sucking bugs have been imported into quarantine for further study. The most promising is a bug that sucks the seeds, and an application has been made to release this agent. First releases are expected early in 2003.

Abstract: *Mimosa pigra* is one of Australia's worst environmental weeds, and has spread across rangeland areas from WA to Queensland. It grows at an alarming rate, and infestations can double in size in just over a year in favourable conditions. The native range of mimosa extends from Mexico to northern Argentina, where it is controlled by more than 440 species of insects and a range of fungal pathogens. An Australian biocontrol project was begun in 1979 and 11 insects and two fungal pathogens have been released, with varying success. Two highly successful agents so far are *Neurostrota gunniella*, which mines green stem tips, and *Carmenta mimosa*, which bores into larger stems and trunks, and reaches the roots in the dry season. The latest agent, a leaf-feeding moth, *Macaria pallidata*, was released in 2002. Several other insects may be released in the future. Other problem rangeland weeds subject to biocontrol include mesquite (*Prosopis* sp.), *Parkinsonia aculeata* (parkinsonia), *Hyptis suaveolens* (hyptis), and *Jatropha gossyiifolia* (bellyache bush).

Keywords: *Mimosa pigra*, weeds, biological weed control, beetles.