Fighting the triffid take-over

Land managers and scientists are battling a widening guerilla war against triffid-like weed infestations. One of Australia's greatest but least known environmental threats, alien plant species cost the country billions each year in containment, eradication and biological control measures. **Louise Lawrence** gives an overview.

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Mesquite has now won vast areas of the semi-arid north. In dense, impenetrable stands, it robustly defends its territory with a repellent armoury of 10 cm thorns.

As an island continent, Australia's unique ecosystems and flora were protected through the ages by isolation. That changed, dramatically, when the first European settlers arrived with foreign crops and ornamental plants. Since then, over 28 000 exotic plants have been brought into the country – only a few accidentally. Many of these alien species escaped their loose domestic controls and, away from natural predators, have revelled in Australia's conditions.

Over 2500 species of introduced plants are now firmly established in the wild. Many are threatening important wilderness areas, and the sheer cost of weed control is ballooning. Every year, half a million dollars is spent just trying to keep mimosa out of Kakadu. Although there are no figures for the total cost of managing environmental weeds, farmers spend more than $4 billion a year. It's a national headache of huge and growing proportions.

In 1997, the Australian Government set up the Natural Heritage Trust (NHT) to help restore and conserve Australia's environment and natural resources. As an integral part of that objective, CSIRO Entomology, supported by the NHT, works on an Integrated Weed Management program. With an emphasis on biological controls, program scientists now cross the world searching original ecosystems for the natural enemies of Australia's weeds. Finding a control candidate is only the beginning of a long and detailed control process (see box on page 29).

The worst weeds can form dense stands over vast areas, displacing native plants and animals and frequently reducing the recreational amenity of more publicly used land. Biological controls are preferred because infestations are often inaccessible, and because of the extensive areas affected and the risk of damage to native vegetation, control by herbicides or other means – such as fire – is restricted.

The NHT-supported CSIRO research focuses on a number of marauding 'Weeds of National Significance'[1]. Its implementation also involves state departments, universities, community groups and landholders. These organisations and CSIRO are partners in the Cooperative Research Centre (CRC) for Australian Weed Management, established to encourage and support research collaboration on sustainable management strategies to control the most problematic weeds.

Temperate weeds

In southern Australia, bridal creeper (*Asparagus asparagoides*), bitou bush (*Chrysanthemoides monilifera*) and blackberry (*Rubus fruticosus* aggregate) are amongst the worst environmental species.

Bridal creeper, introduced from South Africa as an ornamental plant in the 1800s, was once much favoured for wedding bouquets. Fourteen years of research have seen the release of three biological control agents from South Africa; a leafhopper, *Zygina* sp. (1999), a rust fungus, *Puccinia myrsiphylli* (2000) and a leaf beetle, *Crioceris* sp. (2002). The leafhopper and the fungus are

1 See http://www.deh.gov.au/biodiversity/invasive/weeds/wons.html

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Bridal creeper smothers native bush, and its mats of root tubers prevent seedlings from establishing.

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causing impressive damage to bridal creeper in south-eastern New South Wales and Western Australia and are part of a national redistribution program by school and community groups. These agents have now been released at 1500 sites across Australia. The CSIRO Entomology website[2] has information on the bridal creeper work.

Many Australians encounter bitou bush, another native of South Africa, when it restricts their access to the beach. Introduced accidentally in 1908, it was later deliberately planted to stabilise soil and dunes along Australia's east coast. By 2001, bitou bush was found along 900 km (80%) of the New South Wales coast and is the dominant plant species for 400 km.

Biological control started in 1987 and two agents, the bitou bush tip moth (*Comostolopsis germana*) and the bitou bush seed fly (*Mesoclanis polana*) are well established.

In 2001/2002, a leaf-rolling moth (*Tortrix* sp.) was released along the New South Wales coast and has established at four sites. This was not before it worried researchers by not establishing after early releases. It appears now that the larvae had trouble surviving on plants toughened by drought. Rain has produced better

2 http://www.ento.csiro.au/bridalcreeper/index.html

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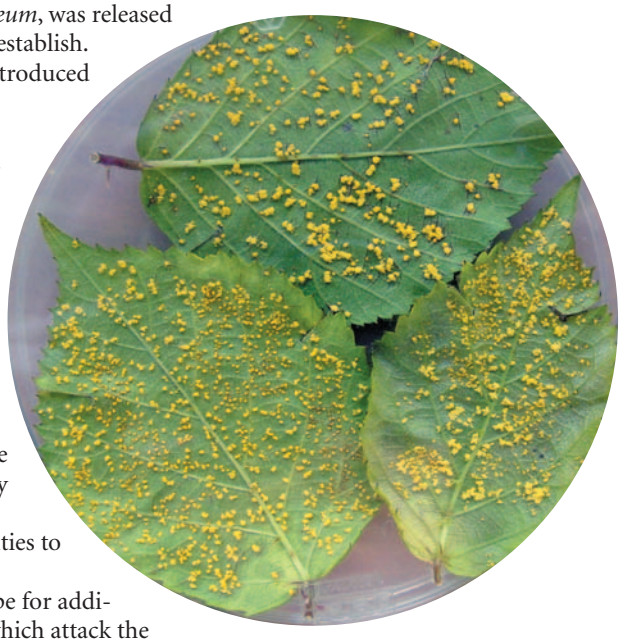
The leafhopper, *Zygina*, is one of the biocontrol agents released on bridal creeper. Also in the photo a rust fungus pustule, another biocontrol agent is being trialled.

Far left: Damage caused to bridal creeper leaves by the leafhopper, *Zygina*.

plants and the moth is now enjoying good quality food.

Many people still enjoy blackberrying but after the introduction of the European blackberry as a horticultural plant, it quickly became a serious weed.

A strain of the blackberry leaf rust fungus, *Phragmidium violaceum*, was released in 1991 but did not establish. However, illegally introduced strains cause some damage in parts of south-east Australia. The blackberry makes life difficult for scientists. In a CRC for Australian Weed Management project, scientists at the University of Adelaide have discovered that the blackberry is not one but at least 15 closely related species with different susceptibilities to the fungus.



One of the new rust strains released on weedy blackberry in early 2004.

A search in Europe for additional rust strains, which attack the other species of blackberry, resulted in eight strains being imported into the CSIRO Black Mountain Containment Facility in Canberra for testing. In February 2004, these strains were approved for release in Australia.

The NHT support is enabling the establishment of experimental sites in NSW where these fungal strains will be released.

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CSIRO Entomology's Ruth Aveyard inspects bitou bush tips for *Tortrix* larvae in an infestation at La Perouse, Sydney.

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An adult leaf-rolling *Tortrix* moth released to control bitou bush.

Tropical weeds

The wide-open spaces and fragile ecosystems of northern Australia are under threat from a number of woody weeds including parkinsonia (*Parkinsonia aculeata*), mesquite (*Prosopis* spp.) and mimosa (*Mimosa pigra*).

Originally from Central America, parkinsonia was introduced because of its attractive foliage and drought tolerance. It is now a serious threat to large areas of northern Australia.

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Left: Parkinsonia's stealthy advance poses a serious threat to wetlands, riparian zones and uplands of northern Australia. Pictured is an infestation in a wetland on the Gulf of Carpentaria. Right: Eggs from the seed feeding beetle, *Penthobruchus germaini*, on parkinsonia pods.

Workers from state departments and CSIRO have a network of study sites across north Australia and CSIRO is conducting surveys for potential biological control agents in parkinsonia's native range between southern Mexico and Costa Rica.

Mesquite is a woody, leguminous shrub, which now infests large areas of the semi-arid regions of northern Australia. Introduced in the late 1800s, it too was brought here deliberately – for its shade and use as a forage plant.

As part of a biological control program by CSIRO, two insects were released in 1998 – a leaf-tying moth (*Evippe* sp.) and a sap-sucking psyllid (*Prosopidopsylla flava*). Only the moth is widely established and it is causing extensive damage to mesquite in the Pilbara.

Biological control, minimising seed dispersal by livestock and floodwaters and the use of fire are considered the only long-term sustainable means for managing mesquite infestation. Research is being undertaken on all of these by CSIRO and also on the development and use of remote sensing and spatial analysis tools for studying and managing mesquite.

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Left: Mesquite is fast-growing and forms thorny thickets metres high. Right: An aerial view of mesquite in the Pilbara.

In late 2003, a 'Best Practice Manual for Mesquite' was launched in the Pilbara containing contributions from state and commonwealth scientists.

Mimosa was introduced to Australia from tropical America in the late 1800s because people were fascinated by the way its leaves folded up when they were touched. But it escaped from the Royal Darwin Botanic Gardens and now forms impenetrable thickets over more than 800 km^2 of the floodplains of the Northern Territory. It threatens Kakadu and other tropical wetlands in Australasia and has recently invaded Queensland.

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Mimosa thickets heavily restrict accessibility, and limit field work, in the tropical north.

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A mating *Carmenta mimosa* pair. It is one of the biocontrol agents released for mimosa.

Biological control provides the most promise for rescuing land the weed has claimed. Eleven insect species and two fungi have been released since 1983 and are now having a noticeable impact. Four of the insects (the flower-feeding weevil, *Coelocephalapion pigrae*, the twig and stem-mining moths, *Neurostrota gunniella* and *Carmenta mimosa*, and the seed-feeding beetle, *Acanthoscelides puniceus*) are flourishing and reducing the density and spread of mimosa.

However, it will take time for these agents to provide widespread control so their use is being integrated with other management options. Meanwhile, the safety of new agents from Mexico is being assessed before their possible release.

An ongoing battle

The battle to control Australia's environmental weeds will be long and costly. Everyone can play a part by being aware of invasive weeds in their area and, where appropriate, reporting infestations.

Travellers need to be particularly vigilant and should:

- understand the danger of moving plant material
- observe quarantine restrictions
- remember permits are required to bring new plant species into Australia
- avoid spreading seeds of invasive weeds into sensitive areas by, for example, mud on hiking boots or car tyres.

Tim Britton

Students learn how to become Weed Warriors with the help of local weed officers.

Enlisting the community

One way of making a contribution to weed management is to link up with Weedbusters Australia[3] or become involved with Landcare Australia[4]. They welcome community involvement. Similarly, the CRC for Australian Weed Management is running the Weed Warriors[5] action engaging schools and their local communities about the impact of weeds and how they can be controlled. The program actively involves school children in the fight against severe local weed problems. They learn about, rear and release approved biological control agents such as insects or fungi, and help local weed officers and land managers. Since its inception in 2002, 125 local Weed Warrior networks have been established around the country, making a valuable contribution to war on our weedy triffids.

3 http://www.weedbusterweek.info.au/about.htm

4 http://www.landcareaustralia.com.au/default.asp

5 Contact Kate McArthur of the Weed Warrior Program: 03 9785 0111

More information:
Cooperative Research Centre for Australian Weed Management: http://www.weeds.crc.org.au/
Weeds Australia: http://www.weeds.org.au/
CSIRO Entomology: http://www.ento.csiro.au/

Biological control approval

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Releasing a biocontrol agent, the psyllid, *Prosopidopsylla flava*, onto mesquite at Mardie Station in the Pilbara.

Each step in the research on a potential biological control requires unanimous approval from 21 independent agencies representing all Federal and State Departments of Environment and Agriculture. Scientists provide the evidence, but don't make the decisions. The key steps are:

1. Declaration of the weed as a suitable target. This includes analysis of the economic and environmental impacts of the weed and the resolution of any potential conflicts of interest.
2. Approval of the list of plants against which the agent will be tested. It is essential that the potential agent does not attack non-target species so the list includes economic and relevant Australian native species. Research is stopped if the agent can develop on non-target plants.
3. Importation of the potential agent into quarantine for full testing for host specificity (preliminary tests may be done overseas) and to clear any parasites and diseases.
4. Permission to release. Even if permission is granted, further testing may be required.
5. Conflict of interest can be resolved under the *Biological Control Act 1984*. There are further checks provided under the *Environment Protection and Biodiversity Conservation Act* 1999[1].

Details on the assessment process are on the Australian Government Department of Agriculture, Fisheries and Forestry (www.affa.gov.au) and Department of Environment and Heritage (www.deh.gov.au) websites.

1 http://www.ea.gov.au/epbc/invitecomment/index.html

The trials and tribulations of field scientists

Field scientists face some big challenges in their search for suitable control agents.

Like an entomological Indiana Jones, CSIRO Entomology's French scientist (with the assistance of his Moroccan collaborators) successfully brought his insects out of Morocco, only to have them die somewhere between England and Australia due to delays in transit.

The recent field season began with a collecting trip into Greece. The start of a new project coincided with once-in-a-century weather conditions where Greece suffered major snowstorms followed by flooding!

On commencement in Darwin, the scientist had to get to know the floodplains and work out how to mix fire, bulldozers, herbicides, insects and fungi to get on top of mimosa, along with experiments conducted in 16-hectare block replicates!

The experimental sites were under a metre of water and would remain that way for months, which made trapping a challenge. However, a resourceful staff member constructed pontoons so the traps could ride out the record wet. The traps even survived crocodile attacks.

At the CSIRO Mexican field station recently, two insect species from the Dominican Republic were brought in for testing. Survival was poor so the field scientist will return to re-collect when he gets over the dengue fever he contracted on the last visit.

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Ricardo Segura from CSIRO's Mexican station collects insects from plants in Central America as part of research into natural enemies of Australian weeds.