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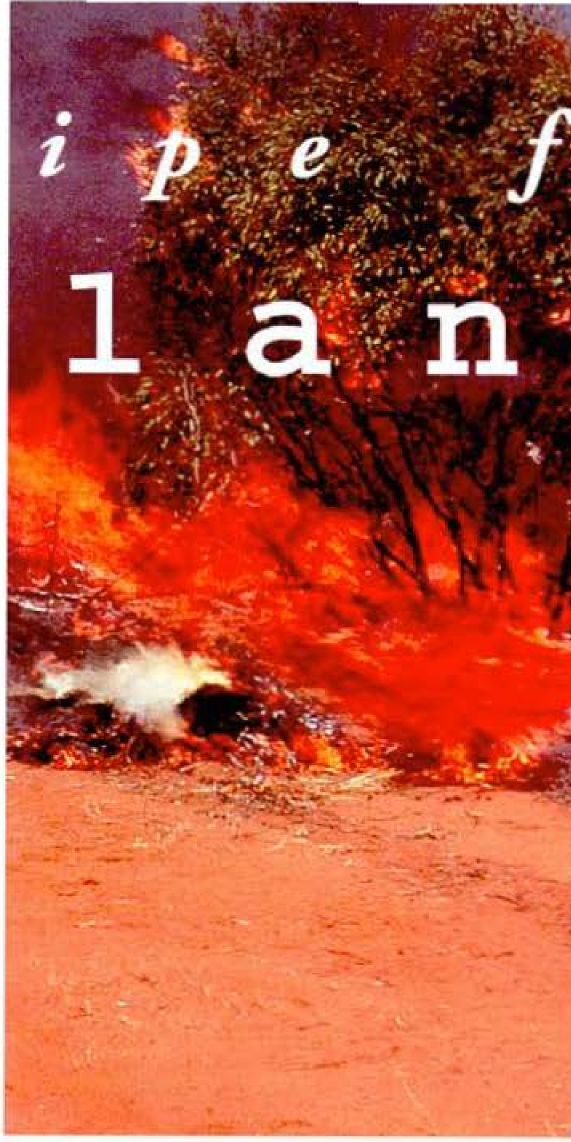
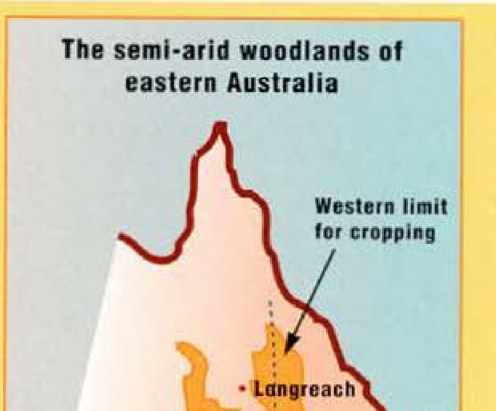


Wayne Deeker outlines a strategy for controlling the spread of native shrubs in Australia's semi-arid woodlands.



The semi-arid woodlands of eastern Australia

Much of Australia's arid and semi-arid pastoral land – from central-west New South Wales to central-west Queensland – suffers from dense infestations of shrubs, the so-called 'woody weeds'. Unlike the tropical and sub-tropical areas further north, however, where introduced shrubs such as mesquite, (*Prosopis* spp.) and prickly acacia, (*Acacia nilotica*) have invaded the pastoral zone, the problem in temperate rangelands is with native species.

Native shrubs thrive in the pastoral conditions of Australia's temperate rangelands. Dense thickets of these shrubs (such as budda *Eremophila mitchellii*, turpentine *E. sturtii*, and punty *Cassia nemophila*) prevent pasture growth, rendering the land unproductive and making stock mustering difficult. The annual cost to graziers in lost production is estimated at about $50-$100 million.

This shrub problem, a symptom of an unbalanced landscape that has been degraded through misuse, has persisted for more than a century because there is no simple solution. The shrubs are a natural part of semi-arid ecosystems, so their eradication is neither possible nor desirable. Controlling their spread depends primarily on restoring the balance by applying appropriate treatments based on an improving understanding of ecological processes in these semi-arid landscapes.

Before European settlement, the spread of these shrubs would have been kept in check primarily by regular fires. But subsequent overgrazing eliminated much of the perennial grass, leaving nothing to burn. This practice, and the graziers' fire-suppression policy, has caused fire frequency to decline.

A regime of less frequent fires allows shrub seedlings to survive beyond their vulnerable stage. Once established, many are little affected by fire. They out-compete native pastures for water and soil-nutrients, becoming difficult to control.

Conventional control techniques have met with only partial success.

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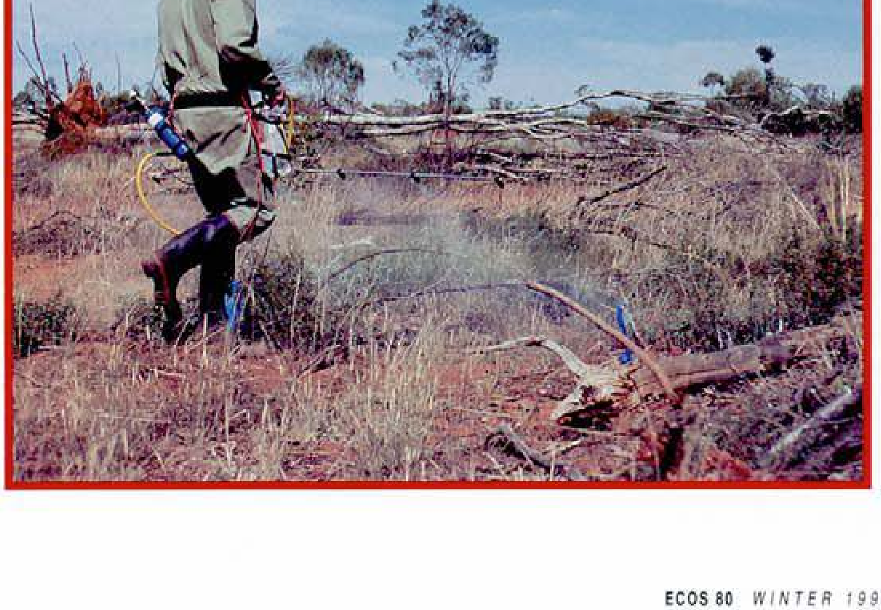
Dr Jim Noble's strategy for controlling native shrubs includes fire and a follow-up application of chemical defoliant at low concentrations. The timing of each control technique is crucial to success.

Chaining and blade-ploughing can be used to kill adult plants, but these techniques are expensive and non-selective. They also cause soil disturbance, a factor that can actually aid shrub seedling recruitment.

Herbicides are effective, but are the most costly control method. They may also be undiscriminating and environmentally polluting if not used carefully. Goats, used as biological control, are only effective with some shrub species and are difficult to manage.

Dr Jim Noble of CSIRO's Division of Wildlife and Ecology says that fire, although shunned as a control technique in the past, is still the most cost-effective tool available for woody weed control. But fires are difficult to arrange since fuel availability depends on sporadic rainfall and careful management of the total grazing pressure (feral, native and domestic herbivores).

Also, the effects of fire are temporary. Many adult native shrubs



are barely harmed, and rapidly resprout from underground organs. The few shrub species killed usually have substantial seed banks in the surface soil, which rapidly provide seedling recruitment after the next rain.

Individually, no control method prevents the recurrence of woody weeds. Effective control demands an integrated approach incorporating follow-up techniques. Methods of this kind developed by Noble and his colleagues at the division are yielding impressive results.

Noble's work follows on from earlier research at Coolabah in New South Wales by the division's Dr Ken Hodgkinson. His work showed that follow-up autumn fires effectively killed 80% of resprouting shrubs (budda *Eremophila mitchellii*, turpentine *E. sturtii*, and punty *Cassia nemophila*), provided the second fire occurred 12 months after the first.

Autumn fires two or more years apart killed only 20% of shrubs. This was because after two years, the shrubs' root systems had recovered sufficiently to withstand the second fire.

Spring fires were much less effective. Autumn fires force the shrubs to grow out of phase with their normal growth period, causing stress. Spring fires, however, less stressful to shrubs adapted to growing in that season, caused low (30%) mortality.

At the same time, Noble has found that two consecutive autumn burns kills all but 15% of two other resprouters, (the mallee species *Eucalyptus socialis* and *E. dumosa*), but that the same proportion survived eight consecutive spring burns.

These experimental burns, however, required the impractical addition of artificial fuel (straw). In solving this problem, Noble drew from the experience of scientists controlling woody weeds such as mesquite (*Prosopis* spp.) in the semi-arid rangelands of the United States. There, chemical herbicides are sprayed first to open up the shrub community and promote herbage growth to fuel the fire.

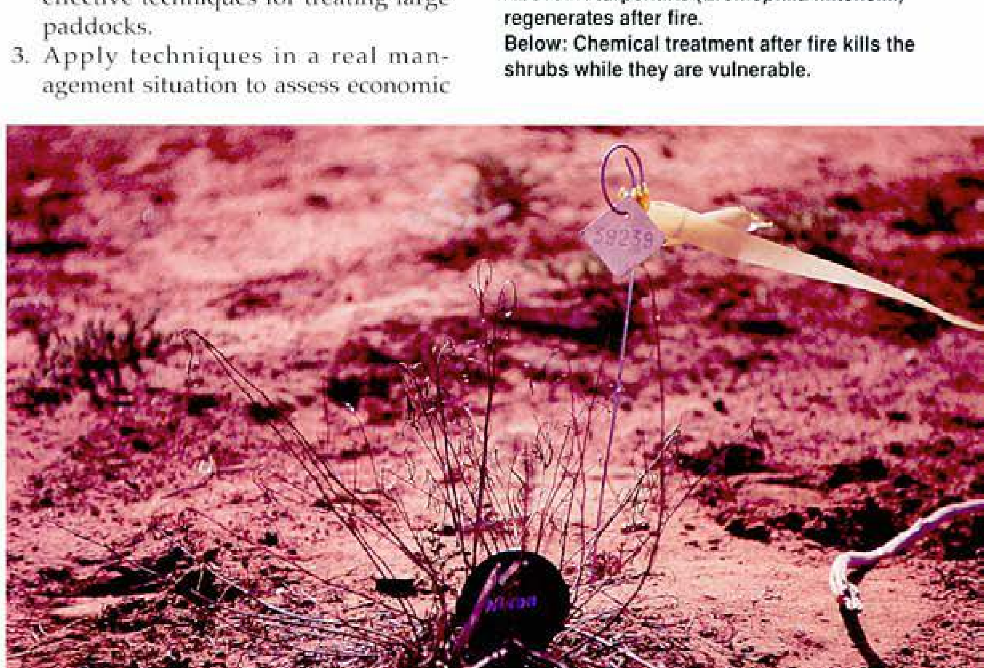
Noble has drawn on, but reversed the US experience, to suit local conditions. The composition of plant species in Australia's, semi-arid woodlands differs from those in the US. As a result, trees overgrowing the shrub understorey sometimes intercept chemical sprays, reducing their efficiency. Dense canopies of certain larger woody weed species (such as budda) also prevent a uniform coverage of spray. For these reasons, Noble prefers an initial fire followed by chemical treatment.

Instead of burning the shrubs a second time, Noble now a uses chemical defoliant at low concentrations, just enough to kill the leaves of the resprouting species. Simulating a second fire in this manner can kill the shrubs while they are still vulnerable.

In 1990, Noble and Dr Tony Grice, of New South Wales Agriculture (now with CSIRO Tropical Crops and Pastures), began an integrated, triple-phased woody weed control project near Cobar in NSW. The project, funded by the Wool Research and Development Corporation, involved three stages:

1. Screen eleven potential chemicals at different concentrations, applying them to different shrub species.
2. Pick the most promising chemicals and fine tune their application rates and techniques, to develop cost-effective techniques for treating large paddocks.
3. Apply techniques in a real management situation to assess economic feasibility and to evaluate operational procedures.

Above: A turpentine (*Eremophila mitchellii*) regenerates after fire.
Below: Chemical treatment after fire kills the shrubs while they are vulnerable.



Noble is now at the second stage of the project. The widely used herbicide glyphosate (Roundup) was chosen for its environmental benignity. It is not soil persistent, and is harmless to animals.

(Glyphosate blocks the shikimic acid pathway in plants, stopping protein synthesis and secondary compound formation. The plant cannot photosynthesise and dies. Animals do not possess this chemical pathway, so remain unharmed.)

The early results are encouraging. Even dilute glyphosate concentrations (1:80) completely defoliate budda and turpentine regrowth when applied as a spot spray. As predicted, the maximum effect comes from applying the dilute chemical to young shoots in autumn.

Noble plans tests to determine the minimum effective concentrations and spray-volumes at paddock scales, involving both ground and aerial spraying. In many regions, water scarcity will be a limiting factor for delivering the right concentration in sufficient volumes. Ultra low volume aerial spraying, (one to five litres a hectare), a technique well established for treating crops, may be used to apply glyphosate to selected patches in large rangeland areas.

Timing important

To be profitable, the chemical applied will have to cost less than $8.50 a hectare. Preliminary spot spraying tests, using a propane-powered spray gun, have come in well under this figure. However, the higher costs of aerial spraying means this approach may only be economic in dense patches.

While the basics of this technique have proven successful, a number of details need to be refined.

The dosage and timing of chemical spray, important in themselves, must be coordinated with the burns. Burns must be timed for maximum effect, and there is much to be learned about timing chemical follow-up sprays. Also, few chemicals, including glyphosate, are registered for use against woody weeds. The approval process takes time.

The fact that burning opportunities usually only occur every 8-10 years, depending on rainfall, also complicates matters. Even after sufficient rain, the fuel must be maintained through control of total grazing pressure (native, feral, and domestic herbivores), itself a complicated process.

Coordinating these factors will be an immense management task. Noble will pool his research results with other members of the CSIRO Division of Wildlife and Ecology Rangelands Program for the development of computer-based decision-support systems. A few prototype packages covering several grazing management problems and fire options are available. Comprehensive versions will eventually be ready for public distribution. Noble expects that these will be used by state land management agencies and, in time, even by pastoral managers.

When all elements are interacting smoothly, Noble's integrated control techniques will allow precise woody weed management.

Noble stresses management over eradication. Only introduced noxious species (such as mesquite and prickly acacia) are to be eradicated, where possible. The rest, he says, are native, so there may even be grounds for maintaining them as groundcover in heavily grazed areas near watering points. The aim, instead, is to identify those fertile patches within a paddock which will provide an economic response to shrub reduction.

Noble believes indiscriminate use of chemicals is inappropriate, but when used as part of an integrated package, and used strategically, can be safe and effective. He says that rehabilitation of shrub-infested rangelands to those with more productive pastures must be part of a larger resource management system, including all aspects of property management (especially management of total grazing pressure).

Starting fire with fire

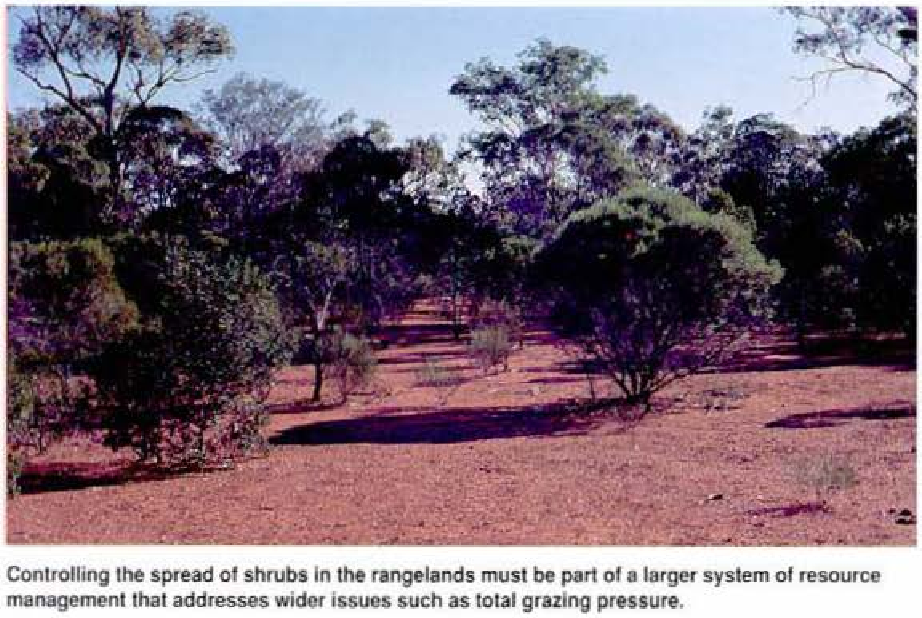
Aerial ignition is the most efficient way of starting large-scale fires for operations studies in the rangelands. Fire breaks 20 to 30 metres wide are prepared beforehand using either drip torches or bulldozers, and burns are planned for when the weather and fuel conditions are satisfactory.

The burns are expensive because of the aircraft and support crews (fire trucks stand by at strategic locations), but worth it because they can ignite huge areas quickly, and safely, especially when fuel distribution is patchy.

A machine which looks rather like a tennis serving machine is fitted to the aircraft. This holds hundreds of plastic balls like ping-pong balls, each containing about a teaspoon full of potassium permanganate (Condy's crystals).

The aircraft flies in parallel lines at low altitudes (60-150 m) above the ground, with a bombardier in the back seat controlling the machine. On instruction from the navigator sitting beside the pilot, the balls are dropped where there is sufficient fuel to sustain the fire.

Before ejection, a spike punctures each ball, injecting a small amount of ethylene glycol (antifreeze). The balls are released up to two per second from a chute at the rear of the aircraft. By the time the balls have landed and rolled a short distance into ground fuel, the chemical reaction has begun, and they burst into flame. In this way, large paddocks can be ignited quickly.



Controlling the spread of shrubs in the rangelands must be part of a larger system of resource management that addresses wider issues such as total grazing pressure.

More about shrub control

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