WEEDS OF NATIONAL SIGNIFICANCE

MESQUITE

(*Prosopis* species)

Strategic Plan

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Supporting information about the National Weeds Strategy, Weeds of National Significance and progress to date may be found at www.weeds.org.au where links and downloads provide contact details for all species, their management committees and copies of the strategy.

This strategy was developed under the leadership of the Dept of Natural Resources, Queensland with full cooperation of all the States, Territories and Commonwealth of Australia.

Comments and constructive criticism are welcomed as an aid to improving the process and future revisions of this strategy.

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CONTENTS

Flower of mesquite

A mature mesquite tree (Prosopis pallida)

EXECUTIVE SUMMARY

Mesquites (*Prosopis* species) are one of northern Australia's worst weeds. They are a group of thorny shrubs and trees that aggressively replace grasslands and thornless shrubland. Most impacts are in pastoral and extensive grazing regions. Current infestations cover 800,000 hectares. Most of the arid to subhumid tropical areas of Australia are however climatically suitable for mesquite, particularly along watercourses and floodplains, although it may also grow on uplands and poses a threat to all areas with agricultural and conservation value. The major challenges for control of mesquites are to build on the existing achievements by landholders, researchers and States in controlling infestations, to remove the current, and prevent the potential impacts on Australia.

The vision of the strategy is that:

Mesquite species and hybrids are confined and eventually eradicated from Australia.

The strategy aims to deliver four desired outcomes:

1 Mesquite management is coordinated and maintained at a national level.

- Monitor and evaluate implementation of the strategy
- Increase education and awareness of the mesquite situation in Australia
- Maximise the availability of resources and the efficiency of use
- Identify economic impacts and incentives/disincentives for control
- Use enforcement as a management tool

2 All core infestations are confined and subject to long-term management, leading to ultimate eradication.

- Define core infestations of mesquite
- Foster mesquite confinement as a component of general resource management
- Refine and adopt best practice management
- Introduce biological control agents and improve their impact

3 All isolated and scattered infestations are eradicated.

- Foster best management practice for mesquite eradication
- Undertake strategic follow-up surveillance and control of treated areas

4 Mesquite species are prevented from spreading.

- Regulatory support to prevent spread
- Establish understanding and awareness of mesquite impacts, identification and spread
- Restrict short and long distance movement of mesquite by livestock and machinery
- Restrict movement of mesquite by feral and native animals
- Develop and maintain early detection / eradication mechanisms

The extent to which these outcomes are met will be evaluated as part of a five-year cycle of review and will determine the success of the strategy.

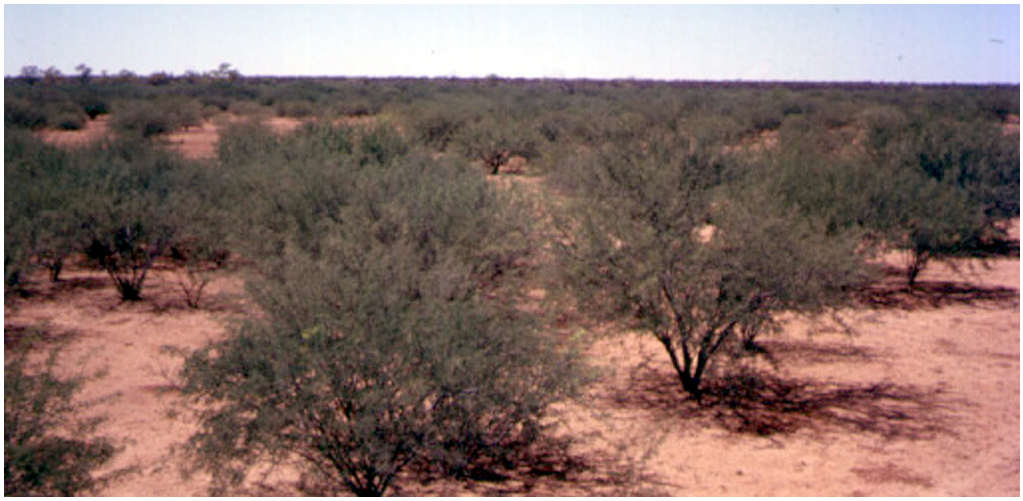
THE CHALLENGE

Mesquite (*Prosopis* species) is the generic term for four species and several hybrids growing throughout the country that make up potentially one of Australia's worst weed genera. This group of species has received international attention because of its widespread impacts on open grassland and woodland ecosystems. It forms impenetrable thickets, smothers native vegetation and hinders primary production. Fifteen years ago, the United States experienced production losses of some $200-500 million per year from mesquite infestations. In Australia, the impacts are not as large to date, but mesquite has the potential to impact on Australia's pastoral region more widely and intensively than prickly acacia.

Mesquite is a thorny shrub or small tree, native to North and South America. It was introduced into Australia as an ornamental, fodder and shade tree around 1900. It has progressed to infest scattered areas of Western Australia, Northern Territory, Queensland, New South Wales, South Australia and Victoria.

There is urgency to prevent this weed from spreading and establishing throughout Australia, particularly in ecologically sensitive and grazing areas. Prevention of spread is difficult as domestic and feral animals easily and rapidly disperse mesquite seeds, as do floodwaters. Even today, plants continue to be deliberately planted in remote areas for shade and land reclamation. However, the net benefits from these species are far outweighed by the potential risks associated with the plants. With the right seasonal conditions new infestations rapidly arise, and once established control costs are high due to the long-term nature of controlling seedlings produced. Early detection and control is therefore required to stop new infestations before they establish.

This strategy was developed with the belief that all stakeholders must consider that not containing mesquite will result in their grandchildren inheriting an unproductive thorny shrubland rather than productive native open grasslands and thornless woodlands. The challenge is to build on the significant existing achievements by landholders, researchers and State agencies in controlling infestations; most mature seed bearing trees across Australia have been killed within the past decade. To eradicate this species, however, monitoring and treatment will be required at treated sites for up to fifty years to control seedlings. The vision of this strategy will not be achieved in the next ten years, it is a vision that looks fifty years from now to a point where these prickle trees no longer threaten the environmental diversity or the agricultural viability of our inland areas due to the combined efforts of the Australian community.



A mesquite infestation in Quilpie shire

1 BACKGROUND

The genus *Prosopis* contains 44 species, of which four have been identified in Australia: *P. pallida* (synonym *P. limensis*), *P. velutina* (synonym *P. flexuosa*), *P. glandulosa* (synonym *P. juliflora*) and *P. laevigata*. In addition to this, hybridisation commonly occurs between species, and at least two hybrids have been identified. The hybrid situation is confusing with the plants being identified under various names. Thus the exact number of species and varieties that have become naturalised is uncertain.

For the purposes of the national strategy, all *Prosopis* species will be considered equally and will be referred to by the term 'mesquite'. This grouping of species is undertaken as the plants look similar, control methods generally do not discriminate between species, and the impacts are similar. The strategy recognises however, that the potential distribution of the various species is quite different and that some species are easier to control. For example, *P. pallida* is more susceptible to fire and mechanical control.

Mesquite is not native to Australia. However, it may be confused with some native species and several other weedy trees. The most easily confused plant is *Acacia farnesiana,* commonly known as mimosa bush/mimosa; the pods and plant habit are similar but the flowers are distinctly different. Other similar looking species include the native *Acacia paradoxa* (kangaroo thorn) and the weeds of national significance: prickly acacia (*Acacia nilotica* ssp. *Indica*) and parkinsonia / Jerusalem thorn (*Parkinsonia aculeata*).

1.1 The biology of mesquite

Mesquite (*Prosopis* spp.) is a thorny shrub or small tree that usually grows to about 3 metres but can reach 15 metres. *P. pallida* has a main single stem and spreading canopy, *P. velutina* is a compact shrub while the hybrids generally grow as smaller multi-stemmed trees with branches drooping to the ground. Trees can appear rather untidy, with zigzag shaped branches. Leaves are fernlike and vary in shape depending on the species. Foliage is usually dark green but can be blue-green. Small greenish-cream "lambs' tails" flowers grow near ends of branches in wattle-like spikes. Seedpods are 10-20cm long, with slight constrictions between the seeds. Each pod contains 5-20 hard seeds. Spines range in size from 4-75mm long and contribute to form impenetrable barriers.

Mesquite possesses characteristics that make it very competitive, including rapid germination of seedlings under a wide range of conditions, rapid vertical penetration of tap roots and long shallow lateral roots, an ability to resprout from dormant stem buds following injury, drought resistance, spines, readily dispersed hard-coated seed, long seed dormancy and high fecundity.

Mesquite generally produces a single crop of seeds per season (Figure 1). Numbers recorded overseas include 630,000-980,000 seeds/tree/year, but these numbers have not been recorded in Australia. In the field it is thought that most seeds may not survive longer than 2-3 years, due to fungal attack or predation but no accurate studies have been carried out. In Condobolin NSW, germination is said to have occurred in seeds that have lain dormant for 50 years while infestations in Broken Hill result from seeds produced in the 1970's. Seedling recruitment depends on standing densities of reproductive trees and may be substantial with densities of 2,750-89,000 seedlings per hectare being recorded in Queensland for *P. pallida*. Despite this level of recruitment, seedling mortality was also high, resulting in an average of 836 seedlings per hectare after a year.

Pods are palatable to animals

Mesquite pods are high in sugar (16%) and protein (12%) and therefore are sought by herbivorous animals. Of these, cattle are considered the most effective dispersal agents, due to their high populations in infested areas, movement and high seed germination (69%) after passing through the gut. Horses are also effective vectors of spread, as are emus, kangaroos, feral pigs and goats. Only 25% of seeds passed by sheep are viable. Seedpods can also be widely spread by floodwaters. Perhaps the most effective dispersal vectors of mesquite are humans, since they have transported the plant across the landscape and across the world for use as an ornamental, shade and fodder tree. Based on experience in the United States, favourable climatic conditions for mesquite germination occur sporadically, possibly once every 20-50 years. Once favourable conditions occur, there are likely

to be dramatic increases in mesquite numbers. In general, soil moisture appears to determine mesquite distribution rather than soil type since mesquite tends to establish most successfully on clay and alluvial soils that have good moisture retention. *P. pallida* has established in areas which receive annual rainfall ranging from 250-1500mm.

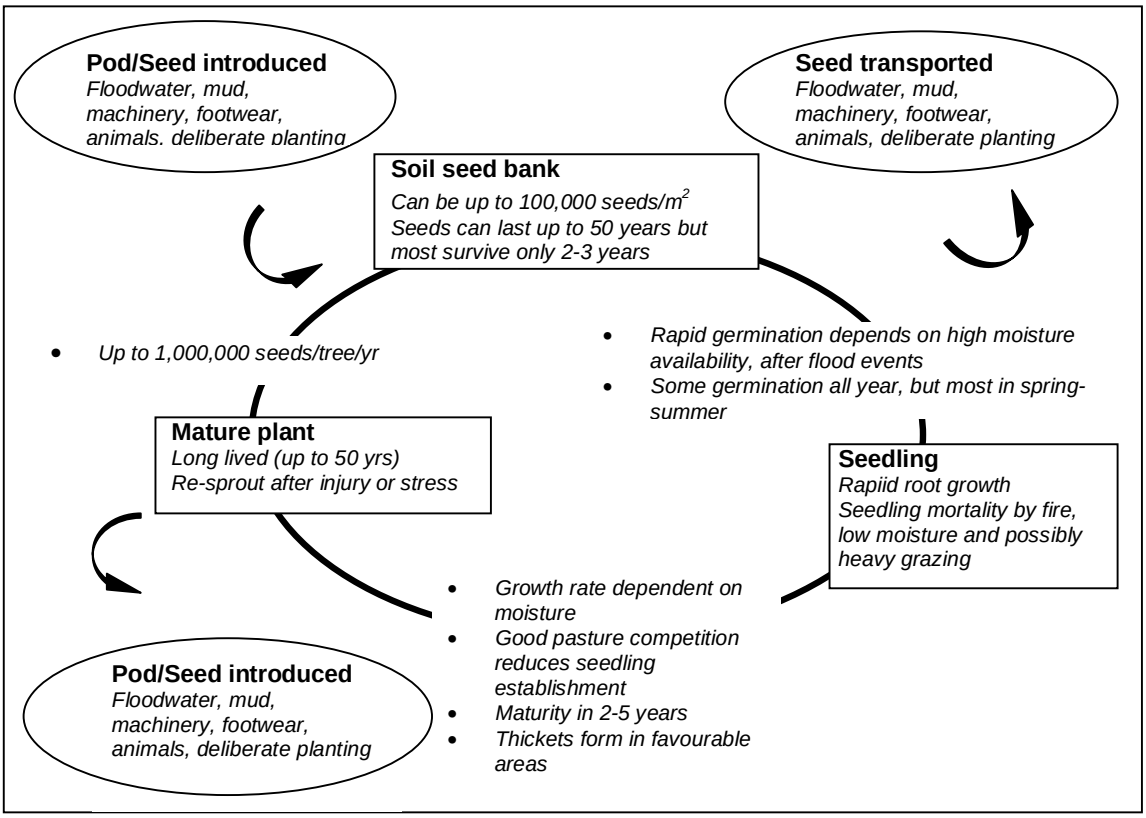


Figure 1. *The life cycle of mesquite.*

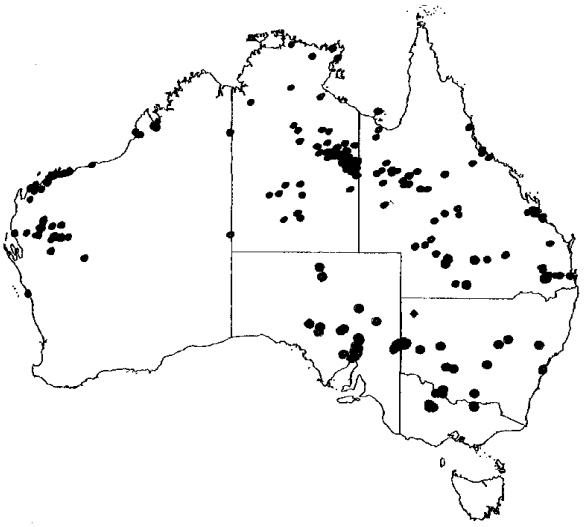
1.2 History of spread

Native to North and South America this genus has been planted all over the globe. Various species are weeds in Israel, Hawaii, Paraguay, Mexico, Argentina, Turkey, Iran and the United States. Mesquite infestations currently occur over approximately 800,000 hectares of Australia (Figure 2). Species of mesquite were first introduced into Australia in Queensland around the early 1900's. By the 1920's and 1930's they were widely planted throughout northern and western Queensland, Northern Territory and Western Australia, primarily as a shade tree around homesteads, but occasionally as shade and fodder trees on bore drains. In New South Wales and Queensland, plants were established around mining areas to minimise dust and erosion hazard. This practice is still carried on in the Northern Territory around isolated communities.

Queensland and NT

Prosopis pallida was widely planted as a shade tree around homesteads in Queensland, although it was grown at Cloncurry to stabilise soil around gold and copper mines. Presently, this species occurs as scattered infestations over 500,000 hectares of Queensland, with most infestations being recorded from north-western Queensland. Dense infestations have been recorded in Cloncurry, Hughenden, Karumba and McKinlay. Lighter infestations occur at Camooweal, Boulia, Winton, Burketown, and in Isisford and Barcoo Shires and to the west of Longreach. *P. pallida* is the only species to occur in the Northern Territory, on the Barkly Tablelands and the Alice Springs districts as scattered infestations or isolated trees.

Figure 2. *Location of recorded mesquite infestations in Australia*



Mesquite was introduced to townships and properties in Western Australia in the 1930's and currently infests over 250,000 hectares. The species are *P. pallida, P. glandulosa* and a hybrid, possibly *P. pallida* x *P. laevigata*. Most infestations occur on pastoral land in the Pilbara and Kimberley regions. The largest infestation is 150,000 hectares on Mardie Station in the West Pilbara (of which 30,000 hectares is dense). Other infestations include: 12,000 hectares of scattered trees south of Derby, 500 hectares of light infestations south of Kununurra, 20,000 hectares of scattered trees in the Upper Gascoyne and 200-300 hectares of light infestations south of Broome.

Queensland

P. velutina (Quilpie mesquite) was introduced onto properties on the Bulloo River in Queensland during the 1930's and the infestation peaked at around 10,000 hectares on the flood plain in the 1980's. Since then, control efforts by officers of the Queensland Department of Natural Resources and landholders, have reduced the plant's rate of spread considerably. Presently isolated infestations are restricted to Quilpie, with dense infestations occurring on two properties. These infestations have been under control in the past but low commodity prices and drought reduced the ability of landholders to maintain control programs. SWEEP (Strategic Weed Eradication and Education Program) is now working in this area. The total area of mature infestations in New South Wales has been estimated at over 19,000 hectares at Milparinka and 8,000 hectares at Broken Hill, as well as minor infestations and reported plants over much of western New South Wales. All infestations had been previously treated with mature plants killed, but these infestations have since regenerated due to lack of follow-up. Two small mesquite infestations found at Swan Hill and Wangaratta in northern Victoria are thought to be *P. velutina*. Control work has previously taken place in these areas, but the current status is unknown.

NSW and Queensland

P. glandulosa (honey mesquite) was introduced in New South Wales to revegetate dust hazard areas. This species is found in the Barnham-Deniliquin and Menindee districts. This is the least common of the species in NSW. This species also occurs as scattered infestations in Rockhampton, Gladstone, Cunnamulla and Charleville in Queensland.

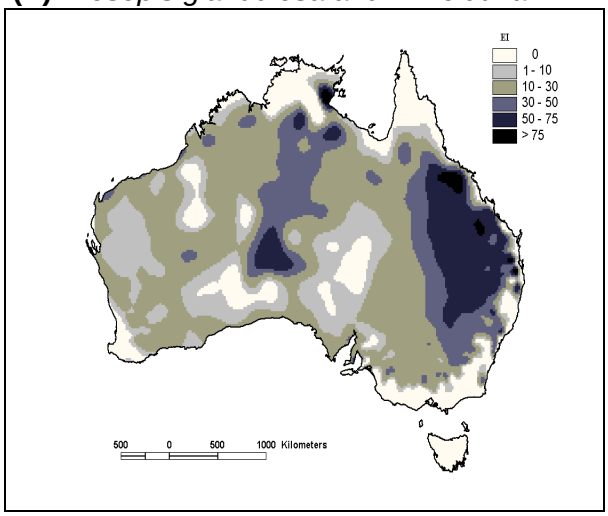
Queensland

P. glandulosa var *torreyana* and hybrid *P. glandulosa* var *torreyana* x *P pallida* were first reported in the Richmond area of Queensland in the 1930's. Presently, about 10,000 hectares infest southwestern McKinlay, as well as Rockvale, Moorooka and Richmond. The McKinlay plants threaten the headwaters of the Diamantina and Hamilton Rivers in the Lake Eyre catchment.

Climate Modelling

The potential distribution of mesquite species was predicted using CLIMEX (Figures 3A and B). This prediction suggests that all mainland states and territories have favourable conditions for mesquite, particularly northern areas above 28^{o}S Latitude. In Western Australia alone, potential distribution of mesquite would be in excess of 25,000,000 hectares in the Pilbara and Kimberley regions, as well as over 500,000 hectares of the saline flats south of Derby. *P. glandulosa* and *P. velutina* were found to have similar potential distributions. These species are suited to eastern areas, but are limited in the southeast by waterlogging stress. *P. pallida* has extensive potential in central Australia but is limited in the south by cold stress.

(A) *Prosopis glandulosa and P. velutina*



(B) *Prosopis pallida*

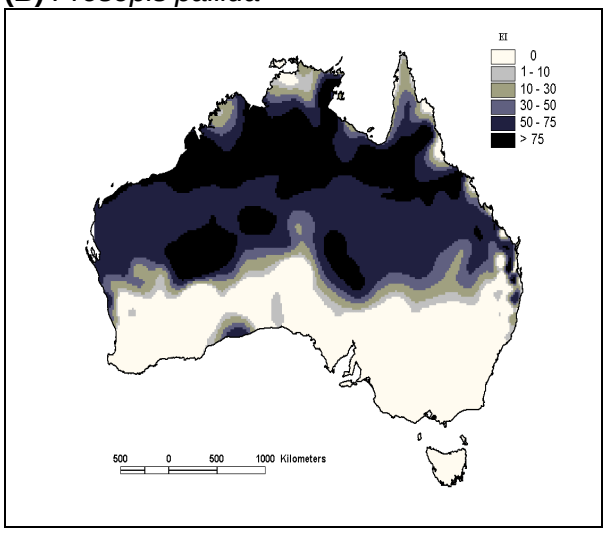


Figure 3.

Potential distribution of three mesquite species in Australia. (Data is splined from a CLIMEX climate prediction. EI=Ecoclimatic Index: EI<30 potential for permanent population low, EI>50 potential very high).

1.3 A weed of national significance

Since mesquites are still in their early phase of spread, current impacts are quite small compared to their potential impacts and can be summarised as:

Environmental:

- Formation of thickets that out-compete ground vegetation through competition for light, water and nutrients and impact on fauna
- Open grasslands and native thornless woody shrublands are vulnerable to being changed to thorny shrublands, with potentially large effects on native fauna and flora
- Feral pigs gather and feed on seedpods further damaging natural vegetation in the vicinity
- Mesquite has been found in Bladensberg and Welford National Parks in SW Queensland and Moorinya National Park in central Queensland, but is subject to ongoing control programs. Its presence in conservation areas in other parts of Australia has not been recorded
- Potentially, all river systems and tidal estuaries in the northern rangeland areas of Australia are vulnerable to infestation by mesquites.

Primary Production:

- Increased difficulty, expense of mustering stock
- Impeded movement and access to water
- Thorns damage to vehicle tyres; animals and primary producers from deep puncture wounds
- Increased water loss from, and maintenance cost of, watering points
- Reduced pasture production and hence reduction in carrying capacity leading to lower cattle and wool production. Infestations can reduce grass production by up to 90%
- Exacerbates and accelerates soil erosion. Evidence from South Africa suggests that mesquite have a dramatic effect on the water table and surface runoff
- Production losses estimated at $25,000/year in NW Queensland
- Potential costs are much higher; in the United States costs amount to $200-500 million annually est. (1985).

Tourism:

- The open grassland and open woodland areas of northern Australia are one of the most attractive and characteristic of the outback. The value of the outback tourism industry is increasing, however mesquite infestations reduce the natural attraction similar to prickly acacia.

Benefits:

- Landholders receive net benefits from mesquite at low densities and during poor seasons. This is in the form of nutrition for

stock, shade and shelter resulting in increased stock survival. Mesquite pods are high in sugar (16%) and protein (12%) and therefore are sought by a variety of herbivorous animals

- Mesquite wood may be harvested for production of barbeque chips or charcoal burned for the fragrance.

1.4 Legislative controls

Prosopis juliflora (and varieties) was declared in Queensland in 1954 and in Western Australia in 1966. The date of declaration in other states has not been recorded. Despite declaration, mesquite continued to spread throughout Australia, due to conscious establishment of the numerous species and hybrids around townships and properties, and dispersal by stock and floodwaters. Since then the pest potential of all species have been recognised and appropriate control actions taken.

Prosopis species have declared status in 5 states and 1 territory.

- Queensland: Category P3 (*P. pallida*) - populations and distribution to be reduced, P2 (*P. velutina* and *P. glandulosa*) - plants to be destroyed, P1 (all other *Prosopis* species) - introduction prohibited
- Western Australia (all species): P1 - prevention of trade, sale or movement, P2 (Mardie Station) - eradicate if not widely established, P3 - control if well established (paddock in Mardie Station)
- New South Wales (all species): Category W1 - plants to be notified and continuously suppressed and destroyed (applies to 31 local government areas of the State)
- South Australia (all species): Category N# - plants to be notified and destroyed
- Victoria (all species): Prohibited Weed (SP) - not occurring or able to be eradicated from the State.
- Northern Territory (all species): Class C/B - must not be introduced and eradicated if found

Some forty other *Prosopis* species could be introduced around Australia. Eight species are considered to be potential pests. The Australian Quarantine and Inspection Service (AQIS) currently prohibit the importation of 8 *Prosopis* species, whilst also maintaining a general prohibition on the genus entering Australia.

1.5 Control to date

Chemical and mechanical methods, grazing management and fire can be used in an integrated control program for all mesquite species and hybrids. All methods may be effective in particular situations, depending on the infestation density, landform, cost/resources, area covered and the management objectives. For example, tall dense infestations may require mechanical control, followed by fire and foliar spraying of seedlings. Isolated multi-stemmed plants such as the McKinlay hybrid may require foliar sprays and are generally more difficult to treat. Isolated single-stemmed plants (*P. pallida*) can be treated using basal bark or cut-stump techniques. Timing is also very important for control actions. Some low rainfall seasons may lead to natural mortality while other seasons result in major recruitment of seedlings. Research is continuing on appropriate control methods of mesquite, including cost-effectiveness. Commercial harvest of mesquite for fuel and chipping has been successful across the globe, but the viability of these industries in Australia is uncertain and proposals are generally not supported, due to the small size and isolated nature of infestations.

Biological Control

Biological control is considered the most cost effective management method for dense infestations but is not well suited for scattered infestations or isolated plants. Agents are able to complement mechanical and chemical control and eradication programs by curbing the dispersal of mesquite, although it has been seen that other control methods may adversely affect insect populations. Seed-feeding beetles, *Algarobius bottimeri* and *A. prosopis* are presently established in low densities but currently only remove a small fraction of the seeds. *Evippe* sp. (a leaf-tying moth) and *Prosopidopsylla flava* (a sap-sucking psyllid) show promise. In lab tests both *Evippe* and *P. flava* performed equally well on Australian mesquites. Recently the moth caused large-scale defoliation at Mardie Station, WA.

Routine Management

Throughout Australia, mesquite control programs regularly take place. The majority of significant infestations of mesquite in Queensland and the Northern Territory have been recently treated. In the remainder of Australia, most infestations have been mapped and many treated, although long-term success of control is difficult to assess and requires continuous monitoring. Appendix 1 outlines mesquite control activities throughout Australia. Projects are

initiated by SWEEP in Queensland ($3,966,729 on 37 projects in 14 shires since 1995), the Declared Plant and Animal Control Fund in Western Australia ($90,000/year), Northern Animal and Plant Control Board in South Australia and DL&WC Mesquite Control Landholder Assistance Scheme in New South Wales. In Northern Territory, landholders are eligible for a 50% subsidy on herbicides for mesquite control and NTDPIF is currently developing a strategic management plan.

1.6 Socio-economic factors affecting management decisions

Landholders often quote the high cost of herbicides and associated labour as an obstacle to control. All control programs require several years of follow-up treatments and many years of vigilance, which may increase the cost, several fold. In areas of large dense infestations, creative funding sources should be explored to develop management programs aimed at containment, impact reduction and beneficial utilisation. This is extenuated by the current poor financial performance of agricultural industries. However, landholders need to recognise that ignoring an infestation could eventually render a property unviable. Control must be carried out on Aboriginal land including the replacement of mesquite species by other more suitable non-invasive plants for outstation dust abatement programs.

1.7 Principles underpinning the plan

The strategic plan is based on the recognition and acceptance of four principles of the National Weeds Strategy:

1. Weed management is an essential and integral part of the sustainable management of natural resources and the environment, and requires an integrated multidisciplinary approach.
2. Prevention and early intervention are the most cost-effective techniques that can be deployed against weeds.
3. Successful weed management requires a coordinated national approach that involves all levels of government in establishing appropriate legislative, educational and coordination frameworks in partnership with industry, landholders and community.
4. The primary responsibility for weed management rests with landholders/land managers, but collective action is necessary where the problem transcends the capacity of the individual landholder/land manager to address it adequately.

1.8 Process followed

The National Mesquite Strategy was developed after a stakeholder workshop held in Brisbane, 1st February 2000. This meeting involved representatives from Western Australia, Northern Territory, New South Wales and Queensland. A draft of the strategy was distributed widely for consultation by all workshop attendees. Over 40 copies were sent to specific interested stakeholders. A notice on the draft strategy was posted to Internet discussion groups, the Local Government Association of Queensland and to State representatives. This strategy takes into account feedback from over 20 stakeholders who commented on drafts as well as input from the management group and interested parties.

1.9 Relevance to other strategies

The National Mesquite Weed Management Strategy has been established to provide a framework for coordinated management of these plants across the country. To date most infestations of these plants are limited to scattered areas of Western Australia, New South Wales, Northern Territory, South Australia and Queensland, but mesquite has the potential to increase in both density and distribution throughout these states and territories. The strategy is linked to other national and state resource plans and groups already involved in mesquite management at the regional and local level, as displayed below.

Scope Scale	Natural Resource Management	Pest Management	Weed Species Management
National	National Strategy for Conservation of Australia's Biological Diversity National Strategy for Ecological Sustainable Development	National Weeds Strategy	Mesquite WONS Strategic Plan
State	Queensland Biodiversity and Natural Resource Management Strategy Forest, River, Estuary and Wetland Policies	Queensland Weed Strategy Northern Territory Weed Management Strategy Western Australia Weeds Strategy New South Wales Weeds Strategy South Australia Weeds Strategy Victoria Weeds Strategy	NT Mesquite Weed Management Strategy NSW State Mesquite Management Plan
Regional	Regional NRM Plans	Regional Pest Management Strategies	
Catchment	Catchment Management Strategies	ICM Pest Management Strategies	
Local	Landcare and Roadside Conservation Plans	Local Government Pest Management Plans (Qld)	Hughenden Mesquite Pest Management Plan (Qld)
Property	Property Management Plans	Property Pest Management Plans	'Comongin' SWEEP plan Mardie Station mesquite management plan

2 STRATEGIC PLAN

VISION

Mesquite species and hybrids are confined and eventually eradicated from Australia.

2.1 Coordinate management

Desired Outcome

Mesquite management is coordinated and maintained at a national level.

Background

The resources required to prevent mesquite spread, eradicate small infestations and to eradicate established infestations in the long term are large. In contrast, the enormous potential costs and impacts of the weed justify commitment of these resources. There is a need to ensure that all available resources are utilised and that all achievements and actions are documented as a measure of progress and success. This is also part of accountability requirements on government and private industry managers to ensure efficient use of resources. Approaches for funding should be co-ordinated to maximise potential success. Management programs are expensive and require on-going landholder commitment to follow-up. Control programs do not have to be government managed. In all situations, enforcement should be considered as a last resort, with primary emphasis on encouraging landholders through involvement in weed management to provide ownership of the issues and consequent outcomes or problems.

Current and potential mesquite infestations cover very large areas across Australia and so management of this weed requires a nationally co-ordinated community approach. Wide community representation is required in discussions as a means of gaining community commitment as well as incorporating mesquite management into a wider land sustainability framework. Reducing the impact of mesquite is an integral part of land sustainability, including management of natural vegetation, other aspects of biodiversity, tourism values and Aboriginal land values. Projects addressing these issues should include mesquite management. Widespread education must take place to raise awareness of these weeds. Actions are particularly important when the public observe local governments and botanical gardens growing these species and may be influenced to do the same. It may not be necessary to have these trees removed if the risk of spread is low, but observers must be aware that these are declared weeds.

Mesquite eradication should not be considered in isolation from other management activities in a property, region or catchment. Attention should be given to the total requirements of landscape restoration rather than for weed control *per se*. Mesquite eradication should be considered along with control and management of other weeds. Further, weed management should be considered as part of property management planning and coordinated with other management activities to maximise the benefits of control and seasonal fluctuations.

Strategy	Actions	Responsibility	Rank
2.1.1 Monitor and evaluate implementation of the strategy	Collate strategic plan milestones and report on progress annually to NWSEC and stakeholders	MMG	1
	Establish and maintain a Mesquite Management Group (MMG)	All stakeholders	1
	Establish a strategy coordinator	MMG	1
2.1.2 Increase education and awareness of mesquite situation in Australia	Produce and distribute information package (social/environmental/economic impacts and management), including survey forms for land managers (Actions 2.3.1, 2.4.5)	States and Territories, NWAP	1
	Produce and distribute identification kit of prickle bushes and alternative plants for all stakeholders	NWAP,State/Territory agencies	1
	Identify stakeholders and direct information to target groups	Workshop delegates/ MMG	1

Strategy	Actions	Responsibility	Rank
	Produce and distribute communication plan to all stakeholders, including system of notification of new infestations	MMG, NWAP, State/Territory agencies	2
	Develop and implement extension and communication plans addressing established and potential mesquite infestations	MMG, State/Territory agencies	2
	Promote and coordinate public awareness	MMG, NWAP	2
	Produce and distribute identification WEEDdeck for all stakeholders	NWAP, State/Territory agencies	2
	Promote opportunities to control or reduce impacts of infestations and highlight achievements	NWAP, State/Territory agencies	2
	Recognise the need for conflict negotiation for some control actions and put procedures in place to manage	State/Territory agencies	2
2.1.3 Maximise the availability of resources and the efficiency of use	Seek and maintain adequate resources for ongoing research on ecology, taxonomy, seed longevity and biological control to improve understanding of management requirements	State/Territory agencies, CSIRO, industry and NRM R&D groups	1
	Seek and maintain adequate resources to assist in ongoing management of mesquite infestations	State/Territory agencies, LGs, landholders	1
	Determine criteria for government assistance versus landholder responsibility	MMG, State/Territory agencies	1
	Market the strategy and coordinate a planned approach to funding sources	MMG, NWAP	1
	Incorporate mesquite management in: • Landholder level property & sub-catchment plans • Local government pest management plans • Regional natural resource & catchment strategies • Vegetation mapping and plans	State/Territory agencies, strategy groups, LGs, landholders	2
	Establish linkages and joint action with other WONS strategies	MMG, State/Territory agencies	2
	Promote integrated weed management to maximise benefits of mesquite control (while also monitoring associated costs)	State/Territory agencies	2
2.1.4 Identify economic impacts and incentives/disincentives for control	Assess the economics of mesquite eradication at different spatial scales (sub-catchment, catchment, regional), including the assessment of specific programs	State/Territory agencies	1
	Determine the benefits and costs of mesquite control for best practice management	State/Territory agencies	1
	Update data on the economic impact of mesquite	State/Territory agencies	2
	Review, document and distribute to all stakeholders information on current and potential incentives and disincentives: • Potential “net” benefit of incentives • Impacts on land values/ rates • Forms of assistance available	State/Territory agencies	2
	Facilitate removal of identified disincentives	State/Territory agencies, MMG	2
2.1.5 Use enforcement as a management tool	Ensure States have legislation to support actions in core and scattered infestation areas	Regulatory authority in State/Territory	1
	Utilise support available from cooperative landholders in encouraging others to meet their eradication responsibilities	LGs, strategy groups	1
	Increase landholder awareness of their current responsibilities under legislation	State/Territory agencies, LGs	1
	Utilise notices where necessary to ensure control aimed at eradication is achieved	LGs, State/Territory agencies	1
	Enforce lease conditions in support of mesquite management	State/Territory agencies	2

2.2 Reduce the impact

Desired Outcome

All core infestations are confined and subject to long-term management, leading to ultimate eradication.

Background

Although the majority of mesquite infestations in Australia are isolated, there are several areas where rapid control is not considered a viable option. This is due to factors such as density and size of infestation, low economic incentive to control, and possibility to manage in order to reduce risk of seed spread to surrounding areas. This strategy outlines these areas as being 'core infestation areas', requiring management and confinement in the short-term. The possible core areas are dense infestations on 'Mardie Station', Western Australia, the Hughenden area and 'Comongin' (Quilpie), Queensland and Broken Hill/Milparinka, western New South Wales.

Integrated management, including biological control, grazing management and fire, have the potential to provide cost effective long-term control of mesquite. There is still potential to improve the effectiveness of control methods for some sites. Biological control, although not effective to date, has the potential to target potential weaknesses in the lifecycle of the weed. Biological control agents need to be distributed throughout infestations. New biological control agents may be introduced, as over 945 insect species and plant pathogens have been recorded attacking all parts of mesquite in its native range. Control techniques should not impact on the effectiveness of biological control agents. Effective follow-up surveillance and control of previously treated areas are essential, due to possible ineffectiveness of primary control methods and the longevity of the seedbank. Commercial harvesting of mesquite species is not supported, as it does not follow the spirit of this strategy, which is to ultimately eradicate this genus in Australia.

Possible landholder complacency to the confinement of mesquite needs to be specifically targeted. At the same time landholder input to refining confinement methods and adapting them to local situations is essential to establish best practice management. Most major populations of mesquite are on pastoral properties characterized by low productivity per unit area. This represents a major challenge in developing economically effective long-term management practices. It should be noted that landholders receive net benefits from mesquite in the form of shade, shelter and fodder for stock, while it is at low densities. However, effects far outweigh the net benefits of the plant. All stakeholders should consider that not containing mesquite would result in their grandchildren inheriting dense thorn forests rather than open grasslands and woodlands.

Strategy	Actions	Responsibility	Rank
2.2.1 Define core infestations of mesquite	Develop a national set of criteria for core infestations	State/Territory agencies, CSIRO	1
	Document and map core areas and make available for general public to review	State/Territory agencies, CSIRO	1
	Regularly review national core areas	MMG, State/Territory agencies	1
	Investigate the use of remote sensing to detect isolated or remote infestations	CSIRO/ QDNR	2
2.2.2 Foster mesquite confinement as a component of general resource management	Develop confinement plans for each infestation according to risk of spread	State/Territory agencies, LGs, catchment groups, Landcare groups, landholders	1
	Incorporate mesquite confinement within overall weed management in property planning	Landholders	1
	Promote the establishment of clean areas within the core areas of infestation via these plans	State/Territory agencies, LGs, strategy groups, landholders	2
	Develop resource management plans for Government lands in these areas consistent with other plans	State/Territory agencies	2
	Survey the presence of mesquite in landscapes and ecosystems and use as an indicator of success of mesquite management	State/Territory agencies, LGs, CSIRO	3
2.2.3 Refine and adopt best practice management	Improve understanding of components of mesquite biology and improve specific control methods as required to support integrated management	State/Territory agencies, CSIRO	1
	Produce State best practice manuals for mesquite management for use in the property planning process (including follow-up)	State/Territory agencies, CSIRO	2
	Use adaptive eradication management to refine best practice for different regions, types of infestations and *Prosopis* species	State/Territory agencies, MMG, Landcare groups	2
	Foster vegetation management (including revegetation) as a component of mesquite management, including species research.	QDNR, NTDPIF, QDPI	2
	Establish best practice demonstration sites	State/Territory agencies, MMG, Landcare groups	3
2.2.4 Introduce biological control agents and improve their impact	Maximise distribution and assessment of potential biological control agents to all core infested areas of Australia	State/Territory agencies, CSIRO, strategy groups, LGs, landholders	1
	Determine impacts of introduced biological agents and interrelationships between them and other control options	State/Territory agencies, CSIRO	2
	Increase the number of biological control species available to impact on mesquite	CSIRO, State/ Territory agencies	2

2.3 Eradicate

Desired Outcome

All isolated and scattered infestations are eradicated.

Background

The present scarcity of mesquite infestations in Australia, combined with the enormous potential of impacts and costs of widespread infestations, is incentive to actively seek to eradicate all detected infestations of mesquite in Australia. A determined approach is necessary throughout Australia to achieve this. This strategy indicates that all infestations outside the core infestation areas need to undergo continuous control activities in order to achieve this and be tackled locally on an appropriate scale (e.g. sub-catchment). Information on the distribution of mesquite, including where control works have been completed, is critical to support planning. The degree of detail required would vary with the scale and purpose of the planning e.g. planning in eradication areas with scattered plants requires knowledge down to single plant level. Advanced methods of obtaining data, such as remote sensing and aerial techniques need to be developed and applied. Collection of mapping data from landholders will greatly add to current data.

A wide range of control options is available for mesquite including chemical and mechanical control. Integrated control has the potential to provide cost effective long-term control of mesquite. There is still potential to improve the effectiveness of control methods for some sites, as there are still information gaps in our understanding of the biology and ecology of mesquite. The effectiveness of these methods needs continuous dissemination to landholders. Control techniques should not impact on the effectiveness of other control methods. Effective follow-up surveillance and control of previously treated areas is essential, due to possible ineffectiveness of primary control methods and longevity of the seed bank.

Possible landholder complacency to the control of mesquite needs to be specifically targeted, as most stakeholders have not witnessed large infestations or they are not aware of the potential costs. At the same time landholder input to refining control methods and adapting them to local situations is essential to establish best practice management. State and local governments are supporting landholder efforts. The majority of detected infestations in Australia have had adult trees killed in control programs to date.

Strategy	Actions	Responsibility	Rank
2.3.1 Foster best management practice for mesquite eradication	Gather existing information of infestation (location/size/density/treatment) at property level	State/Territory agencies, LGs, catchment groups, Landcare groups, landholders	1
	Survey and map all outlying infestations of mesquite (see 2.1.4.)	State/Territory agencies, CSIRO, LGs, catchment groups, Landcare groups, landholders	1
	Develop adaptive eradication plans for each infestation according to risk of spread	State/Territory agencies, LGs, catchment groups, Landcare groups, landholders	1
	Incorporate mesquite eradication within overall weed management in property planning, including Government lands	Landholders	1
	Implement eradication of mesquite outside core areas	State/Territory agencies, LGs, catchment groups, Landcare groups, landholders	1
	Develop best practice control for riparian areas including proactive fencing to prevent infestations	State/Territory agencies, CSIRO	2
	Conduct training in eradication techniques	State/Territory agencies, MMG	2
	Monitor and refine control practices for eradication	State/Territory agencies, CSIRO	2
	Enforce the use of lease conditions in support of eradication	State/Territory agencies	3
2.3.2 Undertake strategic follow-up surveillance and control of treated areas	Undertake regular surveys of previously infested areas	State/Territory agencies, LGs, strategy groups, landholders	1
	Provide assistance and resources to stakeholders for effective follow-up: • Education on suitable conditions for recruitment of seedlings • Appropriate methods of control	State/Territory agencies, LGs	2

2.4 Prevent spread

Desired Outcome

Mesquite species are restricted from spreading.

Background

There is potential for some forty other *Prosopis* species, of which eight are considered potential pests, to be introduced into Australia for various uses. All *Prosopis* species should be declared under legislation to prevent their distribution in all States and Territories so that other species can not cause the problems caused to date. Declaration in the States and Territories where species may be introduced and distributed will define the requirement for all landholders to destroy any plants or seeds. At the same time, research is to be undertaken to accurately determine the pest potential of relevant species, leading to revision of the declaration status of specific *Prosopis* species as required. Similarly, *Prosopis* species are being promoted in permaculture as beneficial for the environment. This genus is also being planted in remote areas for the purposes of dust suppression.

Mesquite's current wide distribution is the product of its deliberate planting as an ornamental and shade plant for stock, as well as from spread by animals and floodwaters. Once mesquite occurs in an area it is possible to restrict some forms of spread. The main dispersal vectors of mesquite seed are animals, both domestic and wild. When livestock are moved by road transport and between paddocks on individual properties, this becomes the single most important mechanism for the long distance dispersal of mesquite. A further trend to cattle from sheep in infested areas will exacerbate this problem. Any attempts to control and contain the weed locally or regionally must address the problems posed by stock movement. Feral pigs are a major vector of seeds, as well as feral goats, horses, donkeys and native animals such as emus and kangaroos. Populations and movements of these animals need to be restricted. As floodwater is another dispersal factor of mesquite, trees must be eradicated from areas where flooding is likely to occur.

Vast areas of Australia are at risk of infestation by mesquites. It is important that those areas are prioritised and regular surveys carried out to detect infestations outside the current known areas. Assistance is needed from the industries and communities of central and northern Australia to prevent spread and to detect new infestations. A wide range of education activities, brochures, signs and communication activities will be required. Protocols to reduce seed spread by all relevant stakeholders are also required.

Strategy	Actions	Responsibility	Rank
2. 4.1 Regulatory support to prevent spread	Prevent importation of all *Prosopis* species into Australia	AQIS	1
	Declare all *Prosopis* species to prevent trade and distribution in all States and Territories	Regulatory authorities in each State/Territory	1
	Promote alternative species for shade and dust suppression	State/Territory agencies, LGs	2
2.4.2 Establish understanding and awareness of mesquite impacts, identification and spread	Determine the relative importance of natural/man-assisted vectors	State/Territory agencies, CSIRO	1
	Document and disseminate impact and spread information	State/Territory agencies, CSIRO	1
	Further investigate the spread of mesquite at a landscape level, including the impact of climate on seedling growth	State/Territory agencies, CSIRO	2
	Develop and implement multimedia mesquite education and awareness activities specific to; mining, tourism, defence, property owners, stock agents/transporters, local government, government staff and general public	National Weed Awareness Project, State/Territory agencies, Landcare	2
	Incorporate mesquite management into training workshops and conferences	State/Territory agencies LGs, Landcare groups	2
2.4.3 Restrict short and long distance movement of mesquite by livestock and machinery	Develop a code of practice for minimising the dispersal of mesquite through stock transport including: • Ensuring weed seed reduction before dispatch or acceptance of livestock from mesquite areas. • Establishment of washdown and holding facilities • Survey of meat works at high-risk sites • Development of a "prickly bush" QA system	State/Territory agencies, industry groups, landholders	1
	Use risk assessment to determine how and where mesquite is most likely to spread	State/Territory agencies	2
	Develop monitoring tools to detect infestations at property level	Landholders	2
2.4.4 Restrict movement of mesquite by feral and native animals	Encourage implementation of feral pig control in Property Management Plans and local area plans	State/Territory agencies, LGs, Landcare groups	2
	Coordinate feral pig control across infestation areas	State/Territory agencies	2
	Establish emu-proof fencing (Mardie Station)	AgWA, Landcare groups	2
2.4.5 Develop and maintain early detection/ eradication mechanisms	Develop/implement an early detection mechanism and implement regular surveys, especially following major rainfall events	State/Territory agencies, LGs, Landcare, landholders	1
	Establish State-based procedures for receiving and responding to reports of new infestations, including specimens in State herbaria	State/Territory agencies, LGs	1
	Maintain an early eradication capacity	State/Territory agencies	1

3 MONITORING AND EVALUATION

This strategic plan is subject to a 5-year review. The Mesquite Management Group will monitor the implementation of the plan as a component of its quarterly meetings. Annual reports will be forwarded to the NWSEC and made available to interest groups in a cost efficient manner, possibly a web page. Monitoring will include review of actions outlined and undertaken by groups implementing plans:

- State weed strategies
- Queensland local government pest management plans
- Catchment management plans
- Project plans developed from the strategic plan
- State of the Environment reporting processes.

Performance indicators for the plan include:

- Increased awareness of mesquite as a weed of national significance
- Declaration of all *Prosopis* species according to level of control
- All infestations are mapped at a property level
- No expansion in current mesquite distribution
- Clear understanding of the social, economic and environmental impacts of mesquites
- Increased delivery of extension material specific to target groups and sites
- Integration of mesquite management into relevant plans and actions
- Increased surveys for infestations of mesquites
- Adoption of vendor declaration and hygiene protocols by industry and landholder groups
- Increased resources for on-ground actions
- Increased action on mesquite at all levels - property, catchment and regional
- Long-term strategies are put in place for eradication of all non-core areas and containment leading to ultimate eradication of core areas
- Progress on removal of disincentives for control of mesquites
- Increased awareness of best management practices
- Increased survey of the conservation status and health of riparian and floodplain areas
- Decreased distribution of scattered mesquite infestations
- Increased management of core infestation areas and decreased impact.

4 STAKEHOLDER ROLES AND RESPONSIBILITIES

Private landholders

To control mesquites on their own lands and eliminate spread to surrounding lands including:

- Property management plans to include mesquite eradication
- Implement best practice management for mesquites
- Eradicate infestations over time
- Control feral pests as potential vectors for seeds.

To be aware of the potential for mesquite to spread onto their own lands:

- Follow good hygiene practices eg. quarantine paddocks for new stock purchases
- Be able to identify mesquite and other woody weeds.

Local Governments

To ensure mesquite is contained and eventually eradicated throughout the local government area by:

- Ensuring that pest management plans include ongoing mesquite eradication activities
- Ensuring that ongoing mesquite eradication is undertaken on all lands under the local authorities control including stock-routes, roadsides and town commons. Survey commons reserves infested - map location and density
- Ensuring that all private landholders engage in ongoing mesquite eradication or containment activities
- Liaising with government agencies and community groups to undertake ongoing mesquite eradication
- Administering and enforcing the provisions of relevant Acts, including notices
- Recognise need for resource allocation on determined priorities for mesquite eradication
- Train other sections of local authority on weed issues eg. environmental health officers.

Utility companies /Agribusiness / Industry

- Develop protocols and washdown facilities
- Ensure awareness of characteristic of the weed
- Become involved in management plans in service regions.
- Alert agencies of new infestations
- Provide input into mapping exercises.

QDNR / NTDPIF / AgWA / NSWAg / PIRSA

To ensure that mesquite is strategically eradicated throughout each State and Territory by:

- Continuing to develop efficient, effective, and appropriate control techniques.
- Providing extension and education services to both rural and urban communities
- Developing best practice management under adaptive management programs
- Support local government enforcement of controls of mesquite
- Liaising with community and industry groups and LGs to coordinate local mesquite eradication activities
- Facilitating and coordinating mesquite containment, control and eradication throughout the mesquite infestations.

Other Government Departments in States and Territories

- To assist in development of codes of practice and ensure uptake by departmental staff
- To ensure mesquite eradication is undertaken on all State managed lands.

Other States and Territories

- To ensure awareness and early detection programs are put in place
- To eradicate all plants when detected
- To declare all *Prosopis* species in all jurisdictions.

Federal government departments and corporations

- Ensure quarantine controls on entry of mesquite (AQIS)
- To ensure uptake by Departmental staff to restrict movement of weeds (agencies that manage land and travel on non-government land)
- To ensure mesquite control is undertaken on all federally managed lands (Defence, Environment Australia and other Commonwealth departments/ corporations that manage land)
- Oversee and manage federal funds including Natural Heritage Trust and National Weed Program (Environment Australia, Agriculture, Forestry and Fisheries – Australia).

5 ADDITIONAL READING

Csurhes S (ed.) 1996 Mesquite (*Prosopis* spp.) in Queensland. Pest Status Review Series- Land Protection Branch, Queensland Department of Natural Resources.

DeLoach CJ 1988 Mesquite, a Weed of Southwestern Rangelands: a Review of its Taxonomy, Biology, Harmful and Beneficial Values and its Potential for Biological Control. United States Department of Agriculture.

Parsons WT and Cuthbertson EG 1992 Noxious Weeds of Australia. Inkata Press, Melbourne.

van Klinken RD & Campbell SD (in production) The Biology of Australian Weeds: *Prosopis* L. species. For submission to *Plant Protection Quarterly.*

6 GLOSSARY

AgWA	Agriculture Western Australia
AQIS	Australian Quarantine and Inspection Service
CLIMEX	A simulation modelling system developed by CSIRO
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EI	Ecoclimatic Index
DL&WC	New South Wales Department of Land and Water Conservation
ICM	Integrated Catchment Management
LG	Local Government
MMG	Mesquite Management Group
NSWAg	New South Wales Agriculture
NRM	Natural Resource Management
NTDPIF	Northern Territory Department of Primary Industries and Fisheries
NWAP	National Weeds Awareness Project
NWSEC	National Weed Strategy Executive Committee
PIRSA	Primary Industries and Resources South Australia
QA	Quality Assurance
QDNR	Queensland Department of Natural Resources
QDPI	Queensland Department of Primary Industries
SWEEP	Strategic Weed Eradication and Education Program
WONS	Weeds of National Significance

Appendix 1 Outline of Previous Activities to Control Mesquite Throughout Australia

Queensland

In Queensland, the Strategic Weed Eradication and Education Program (SWEEP) has spent $3,966,729 on 37 projects to control infestations across 14 shires since 1995. Approximately 80% of infestations in northwest Queensland and around Quilpie have been treated by this program. Outlying infestations around the State are subject to continuous control.

Northern Territory

Six properties in the Barkly Tablelands are infested by *Prosopis pallida*, of which the majority occurs in the upper Georgina catchment. Two biological control agents have been released. In addition to this, the following areas have been chemically treated:

- Austral Downs - 100% treated
- Alroy Downs (biggest infestation in Northern Territory of 10,000 hectares) - 50% treated
- Brunette Downs - 95% treated
- Rockhampton Downs - 60-70% treated
- Alexandria Downs - strategic management plan in place. All outlying trees treated, totalling 80% treated
- Lake Nash - 10% treated

Landholders are eligible for a 50% subsidy on herbicides for mesquite control. Control of infestations in the Alice Springs and Victoria River Districts has not been recorded to date.

New South Wales

Control efforts on all known infestations were carried out throughout New South Wales from 1969. In 1992 the last mature tree in the State was removed. However, due to lack of follow-up control activities by landholders, populations in western New South Wales have since returned to the level experienced in the 1970's.

South Australia

Some control work had been carried out at the following locations in 1988:

- Woomera township, Port Augusta saltworks, Port Augusta township, Wallerberdina Station, Arcoona Station, Cockburn township, Iron Knob township, Kokatha, Lake Torrens, Maldorkey, Nectar Brook, Quorn township, Whyalla township, Wilkatana, Wompinie.

Isolated infestations at 12 other sites were treated before and after this time. Few sites are regularly monitored for reinfestation throughout the State.

Western Australia

Approximately $80-90,000 is spent per annum on control of mesquite infestation, of which 80% is spent on increasing awareness. The Declared Plant and Animal Control fund was set up in pastoral areas, where money provided through landholders' rates is placed into a fund and matched dollar for dollar by the State Government for control work of declared plants and animals carried out on pastoral leases. The only recorded control projects are on Mardie Station, where a buffer zone has been established.

Victoria

Small infestations at Swan Hill and Wangaratta have previously been controlled, but the current status of these infestations is not known.