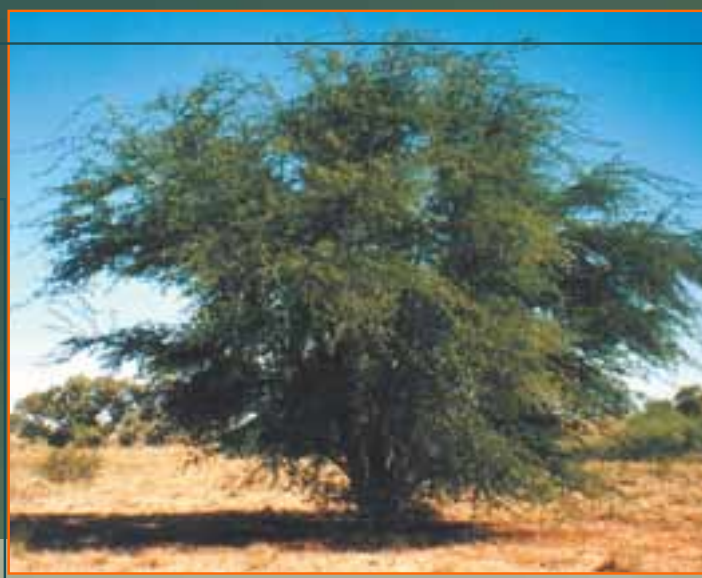
Best Practice Manual

Mesquite



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National Prickle Bush Management Group

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Mesquite

Control and management options for mesquite (*Prosopis* spp.) in Australia

October 2003

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Foreword

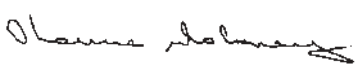
Mesquite is one of Australia's worst weeds. While it already infests nearly a million hectares, its capacity to thrive in a range of climates, soils and landscapes means that over 70% of the Australian mainland is threatened.

However, as the vast majority of current mesquite infestations are relatively small and sparse, it is critical that all possible efforts be directed to confining, controlling and, where possible, eradicating this weed. If mesquite is not controlled, it is likely that future generations will inherit an unproductive thorny shrubland.

The National Prickle Bush Management Group recognises that only through the combined efforts, diligence and commitment of all affected landholders, community and catchment groups, agencies and others will we effectively gain ground on this weed.

This manual brings together, for the first time, a comprehensive range of control and management tools for combating this weed. I recommend the manual to all landholders affected by mesquite and suggest its reading to others at risk of invasion.

Further, I commend all those who have been responsible, both directly and indirectly, for its production.



Louise Moloney
Chairperson
National Prickle Bush
Management Group

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Introduction

Mesquite

A Weed of National Significance

Mesquite (*Prosopis* species) is an exotic plant that has been recognised as a Weed of National Significance due to its invasiveness and subsequent ecological, economic and social impacts.

The impacts on landholders include reduced pasture production and mustering and watering difficulties. As its thorns are dangerous, mesquite may also harm people and damage stock and infrastructure. Its impact on the environment includes loss of biodiversity, change to natural landscapes and an increase in land degradation. It also provides refuge for feral animal populations.

Mesquite is by no means a new problem to Australia. It was introduced in the late 1800s, but appeared to be no threat until favourable conditions in the mid-1900s provided it with the opportunity to spread vigorously. It now covers almost one million hectares of Australian land—only a portion of the total area at risk of invasion. Mesquite has the ability to become more of a problem than prickly acacia (*Acacia nilotica*) if control programs are not carried out (ARMCANZ & ANZECCFM 2001).

A national approach

To tackle the current and potential threat of mesquite, a national strategy was launched in 2001. The vision of this strategy is that 'Mesquite species and hybrids are confined and eventually eradicated from Australia'. Further, the aim of the strategy is to deliver the following four desired outcomes:

1 Mesquite management is coordinated and maintained at a national level.
2 All core infestations are confined and subject to long-term management, leading to ultimate eradication.
3 All isolated and scattered infestations are eradicated.
4 Mesquite species are prevented from spreading.

The strategy is being led by the National Prickle Bush Management Group (NPBMG). Comprising agency and community representatives from across Australia, the NPBMG is responsible for overseeing and monitoring the implementation of the national strategies for the three Weeds of National Significance, mesquite, prickly acacia and parkinsonia.

Use of this manual

The control and management options presented in this manual are the combined results of years of trials carried out by many dedicated researchers, landholders, herbicide companies, government officers, landcare groups and others. The variations between mesquite plants and infestations, and their subsequent differences in response to control methods, have provided many challenges for those involved in the trials. It is a credit to these people that a range of control and management options for the different forms of mesquite are now available.

It is hoped that this manual, which aims to provide the most current information on mesquite in Australia, will be an invaluable reference tool equipping all land managers with the necessary skills and knowledge to achieve their individual goals.

Section 1

Mesquite–ecology and threat

Section 1

Mesquite–ecology and threat

Description

All mesquites are very similar in appearance and can be easily confused. For the specific identification of mesquite, a specialist should be consulted.

Mesquite can be either a multi-stemmed shrub with branches drooping to ground level, or a single-stemmed tree with a spreading canopy that can grow to 15 m in height. *Prosopis pallida* is often a single-stemmed tree with a wide girth, while the remaining species and hybrids are generally multi-stemmed shrubs that can grow to 10 m, but are more commonly 3–5 m high.

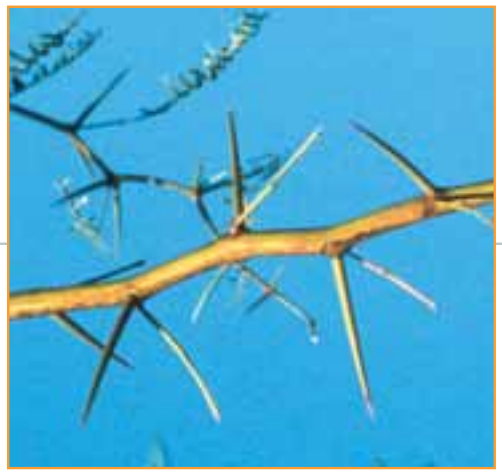
Throughout this manual, the different types of mesquite will be referred to as either tree form, which are mostly single-stemmed (*P. pallida*), or shrub form, which are mostly multi-stemmed (*P. velutina*, *P. glandulosa*, *P. juliflora* and all hybrids).

The foliage is usually dark green but can vary to bluish green. Twigs are smooth, with dark red or green bark. Older bark is rough and grey or brown in colour. The trees often look untidy, with individual zigzagged twigs sticking out beyond the main canopy.

▸ Shrub-form mesquite.

▲ Tree–form mesquite can grow to 15 m.

▲ Shrub-form mesquite.



▲ Thorns originate just above the leaf axis.

Mesquites are mostly thorny, although some thornless variations can occur. Thorns usually occur in pairs above each leaf stalk or along the main stem. They can range in length from 4 mm to more than 75 mm.

Flowers

Flowers are greenish yellow in colour. They are grouped in spike-like clusters on short stalks giving the overall appearance of a cylinder-shaped 'lamb's tail'. They are 5–12 cm long.

Flowers of all mesquite varieties have similar characteristics. The lamb's tail appearance of the flowers is a distinguishing characteristic of the *Prosopis* species.

◀ Lamb's tail appearance of the mesquite flowers.

Pods

Seed pods are 5–20 cm long, straight to slightly curved, smooth, and with slight constrictions between the seeds. Ripe pods are straw-coloured or sometimes purplish. Each pod contains from 5 to 20 hard seeds, which are round or oval in shape.

▲ Variation in pod colour.

Leaves

Leaves of mesquite are fernlike in appearance. Each leaf has 1–4 pairs of leaf branches (pinnae), with each branch having 6–18 pairs of individual leaflets (leaves). Leaf characteristics of the different mesquite species vary (refer to illustrations over page for more detail).

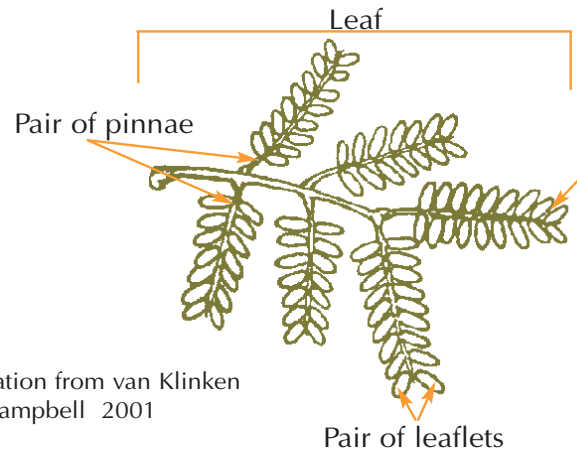


Illustration from van Klinken and Campbell 2001

Figure 1
Mesquite leaf with three pairs of pinnae. The pinna is the smallest individual branch that holds the leaves; they always occur in pairs. The leaflet is the smallest individual leaf.

Identifying mesquite species

Telling the different species of mesquite apart can be quite difficult. The main differences occur with the leaflets. More detail is given in figure 2, below.

Figure 2
(a) *P. pallida* branch with flower; usually 2–4 pairs of pinnae; leaflets are spaced closely together.
(b) *P. velutina* branch; two pairs of pinnae; leaflets close together.
(c) *P. glandulosa* branch; one (sometimes two) pairs of pinnae; leaflets widely spaced.
(d) On hybrids, leaves can vary greatly from plant to plant. This hybrid has long, widely spaced leaflets.

Note: Hybridisation can occur between two or more species and can result in a range of intermediate characteristics.

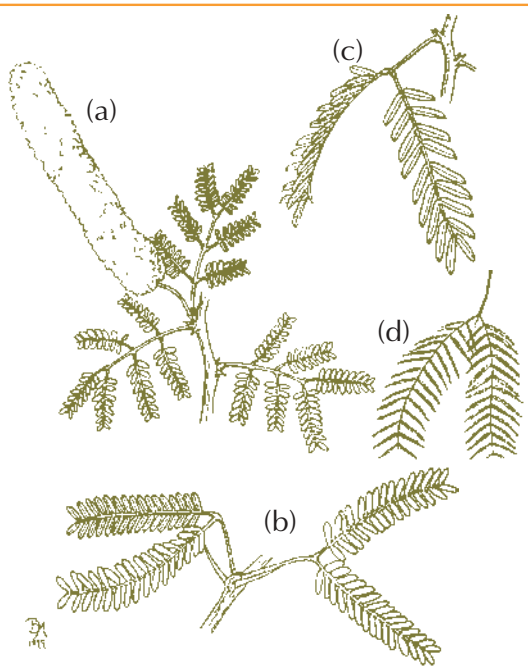


Illustration from van Klinken and Campbell 2001

Important note
As mesquite species vary in their weediness and their response to control methods, it is important to identify them correctly before starting any control work. Inspect plants closely; if in doubt about their identification, consult your local weeds officer, or send a sample to your state or territory herbarium. When doing so, aim to include the different plant features that are present.

Distinguishing between the 'prickle bushes'

Mesquite is often confused with other prickle bushes such as prickly acacia, parkinsonia, mimosa (*Mimosa pigra*) and mimosa bush (*Acacia farnesiana*). These prickle bushes, with the exception of mimosa bush, are also Weeds of National Significance.

It is possible to tell the difference between prickle bushes by the appearance of the flowers and pods. However, if neither of these is available, they can be distinguished by their bark colour and, in some cases, their leaves. As this can be difficult, a local weeds officer should be consulted.

The major differences between the prickle bushes are listed in table 1 (overleaf).

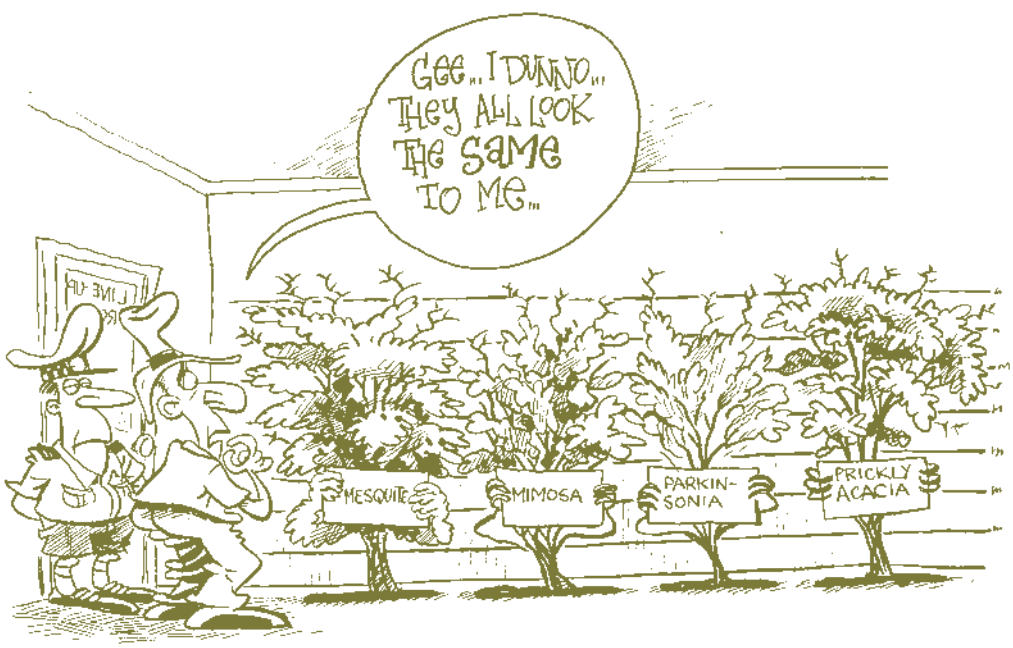


Table 1: Differences between prickle bushes

	Mesquite *Prosopis* spp.	Prickly acacia *Acacia nilotica*	Parkinsonia *Parkinsonia aculeata*	Mimosa *Mimosa pigra*	Mimosa bush *Acacia farnesiana*
Pod shape	Up to 20 cm long; slight constrictions between seeds; straight or slightly curved	Up to 23 cm long; constrictions between seeds	Up to 10 cm long; thin constrictions between seeds; straight	3–8 cm long; one-seeded, bristled segments, which fall away from the pod leaving a skeletal outline	Cigar-shaped; up to 6 cm long; slightly curved
Pod colour, hairiness	Straw-coloured, sometimes purple; no hairs	Blue-grey; fine hairs	Straw-coloured; no hairs	Brown when mature; covered with dense bristles	Brown to black; no hairs
Flowers	Cylindrical, greenish-yellow spike, 5–8 cm long	Ball-shaped, golden yellow, about 1 cm across	Five petals, mainly yellow, one with an orange spot	Round, fluffy, pink or mauve balls, 1–2 cm across	Ball-shaped, golden yellow, about 1 cm across
Leaves	Fernlike; 1–4 pairs; often with a gap between leaves	Fernlike; 4–10 pairs; often overlapping	Long, flattened leaf stalk with tiny oblong leaflets along each side	Central leaf stalk prickly; 20–25 cm long. Each leaf contains about 15 opposite segments, 5 cm long and divided into pairs of leaflets that fold up when touched or injured	Fernlike; 2–4 pairs; with a gap between leaves
Leaflets	6–18 pairs	10–25 pairs	——		8–18 pairs

Table 1: (continued)

	Mesquite *Prosopis* spp.	Prickly acacia *Acacia nilotica*	Parkinsonia *Parkinsonia aculeata*	Mimosa *Mimosa pigra*	Mimosa bush *Acacia farnesiana*
Tree shape	Variable—either a multi-stemmed shrub to 5 m, or a spreading tree to 15 m	Spreading tree to 10 m	Small tree or shrub usually to 5 m	Multi-branched shrub to 5 m	Usually rounded shrub to 3 m
Bark	Rough, grey; smooth dark red or green on small branches	Tinge of orange and/or green on saplings; dark and rough on mature trees	Smooth and green; straw-coloured and lightly textured at base of older trees	Stems green at first; becoming woody; initially covered with thick hairs	Grey, with prominent white spots
Branch shape	Zigzagged	More or less straight	Slightly zigzagged	More or less straight	Zigzagged

For further information on the identification of prickle bushes refer to section 5, p.86.

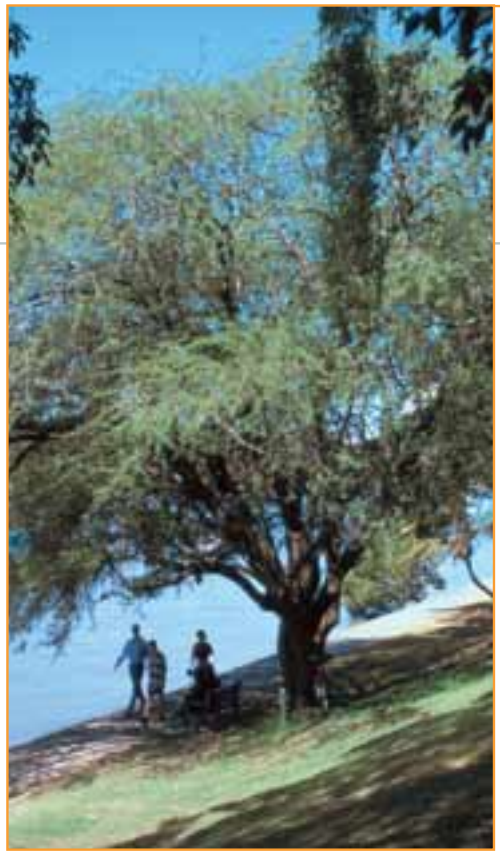
Different features of the prickle bushes

Ecology and biology of mesquite

Little information has been gathered to date on the growth, development and invasiveness under local conditions of the mesquite species present in Australia. However, available information from the countries of origin can be used to predict how the plants may behave in this country.

Mesquite is long-lived

One thing that is clearly evident about mesquite is that, once established, it can be very long-lived, even in the harshest of environments. In the United States, one of the countries of origin, plants at one location were believed to have an average age of 33–44 years, with the oldest trees estimated to be over 170 years old. In Australia, a single mesquite plant growing in the Botanic Gardens in Brisbane is known to be more than 115 years old, and large trees growing around the township of Hughenden in north-western Queensland have been there for more than 40 years, according to long-term residents.



▲ 115-year-old tree growing in the Botanic Gardens, Brisbane.

This longevity may help explain why very few dead plants are ever observed in mesquite infestations. This has serious implications for management, as it means that once established, a plant will continue reproducing indefinitely if not controlled.

Preferred habitats

In Australia, mesquite infestations can be found in climatically diverse regions—from areas with annual mean daily temperatures of 10˚C to 15˚C in the south, to over 25˚C in the north, and with median annual rainfall from as low as 150 mm to as high as 1200 mm.

Populations often begin along riparian zones, where dispersal is relatively easy, and favourable conditions for recruitment occur most frequently. This represents an early phase of invasion. However, mesquite is also superbly adapted to upland habitats where it can rapidly form dense populations in a range of conditions and soil types (from sandy, to loam, to cracking clay). This transition has been observed repeatedly around the world.

In its native range, mesquite grows naturally in exceedingly harsh conditions, (e.g. in Death Valley in California where the annual average rainfall is as low as 50 mm, and daily average maximum temperatures in summer are close to 45˚C). Some of the many adaptive abilities that allow mesquite to thrive under such conditions are:

- *The ability of roots to adapt to a wide variety of soil conditions.* Roots can grow upwards towards the soil surface to capitalise on little rainfall, but can also grow to depths of 80 m and extend laterally more than 30 m. This is the most extensive root system of any plant in the world.

- *Large carbohydrate reserves stored in the roots.* These reserves act as a buffer against environmental stress and serve as a carbohydrate source for new growth following defoliation, allowing mesquite trees (and even seedlings) to survive repeated top-kills and many years of constant defoliation.

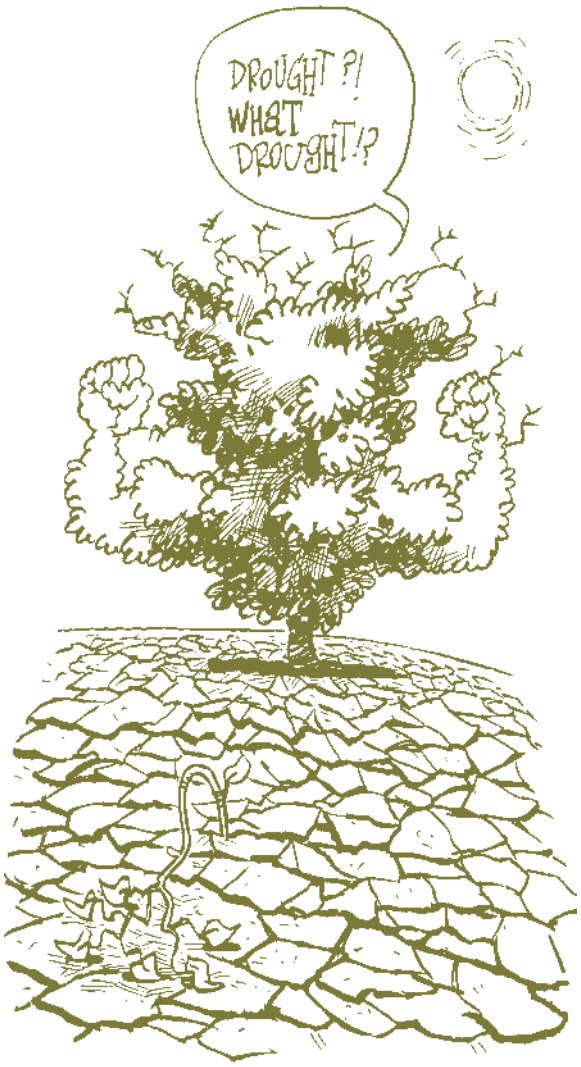
▲ Extensive root system.

- *The ability to alter leaf properties to minimise water loss.* Under arid conditions, the plant can modify to reduce stomatal conductance, change leaf orientation, increase wax accumulation and pubescence, increase leaf thickness and decrease leaf size. This minimises wastage of scarce water.

- *The ability to extract soil water and actively photosynthesise when soil moisture is so low that most other desert plants shut down or die.* Mesquite can actively grow even during prolonged drought.

- *The ability to defoliate under stressful conditions.* This allows the plant to essentially shut down during cold, dry, winter conditions or prolonged drought, conserving root reserves for refoliation once conditions improve.

  Nevertheless, if abundant moisture is available, mesquite can be a greedy water user and will take the opportunity to grow rapidly while favourable conditions prevail.



Rate of spread

The ability of mesquite to increase in density from low levels can be related to a number of factors—most importantly, substantial seed production, an effective dispersal mechanism, and favourable environmental conditions for seed germination and subsequent seedling survival.

Reproductive ability

Field observations in Australia suggest that plants generally produce their first flowers and seeds when they are between two and five years old, although pod production within one year has been observed under ideal conditions. Mesquite flowers predominantly in spring and early summer, with pods taking two to three months to mature.

Mesquite plants can produce large quantities of seed, although the number of pods produced by trees can vary greatly from year to year, and from plant to plant. While there are no figures available for pod production in Australia, estimates for large trees growing overseas range from 16 kg of pods annually, to as much as 367 kg. In terms of seed production, this equates to about 140 000 seeds at the lower range, and millions of seeds for very large trees growing under favourable environmental conditions.

▲ Horses will readily spread mesquite.

Several mesquite species are known to be self-incompatible, which means they require cross-fertilisation between plants before pods can be produced. This may help explain field observations at certain locations in Queensland where mature, isolated trees do not appear to have produced any seedlings.

Dispersal

Mature pods have high sugar and protein content and are highly sought after by many native animals (e.g. emus, kangaroos and wallabies); domestic animals (e.g. cattle, horses and sheep); and feral animals (e.g. pigs).

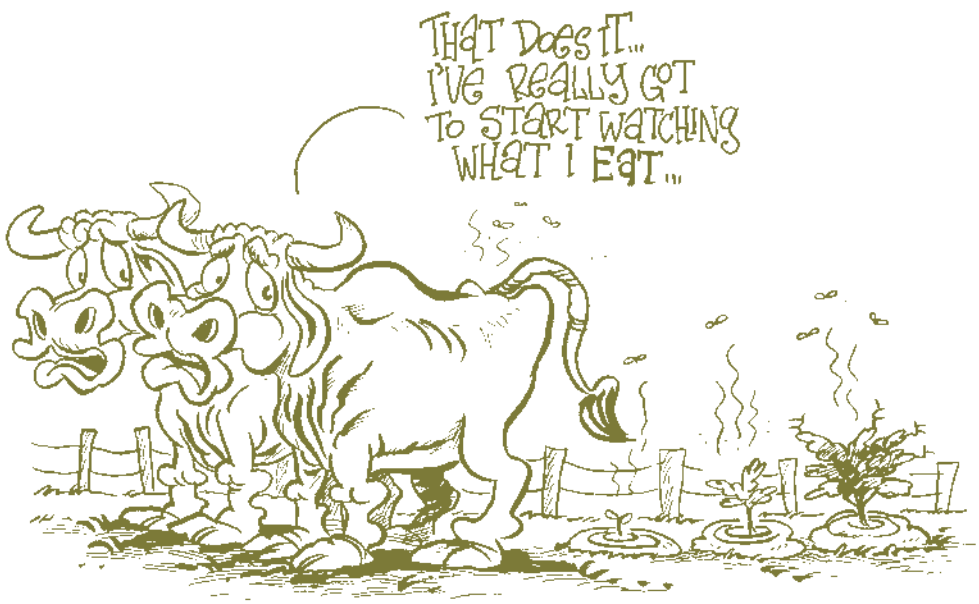
Seed survival rate through the gut can differ greatly between animals—being high (>70%) in cattle, and relatively low (<25%) in sheep and other herbivores that masticate their food. Animals also differ in the way they disperse—that is, how far they can travel from water, or how successfully they can get through fencing. This, in turn, can have an important effect on the way consumed seeds are dispersed, especially as some can take more than a week to pass through the gut.

▲ Seedling growing in kangarooo manure.

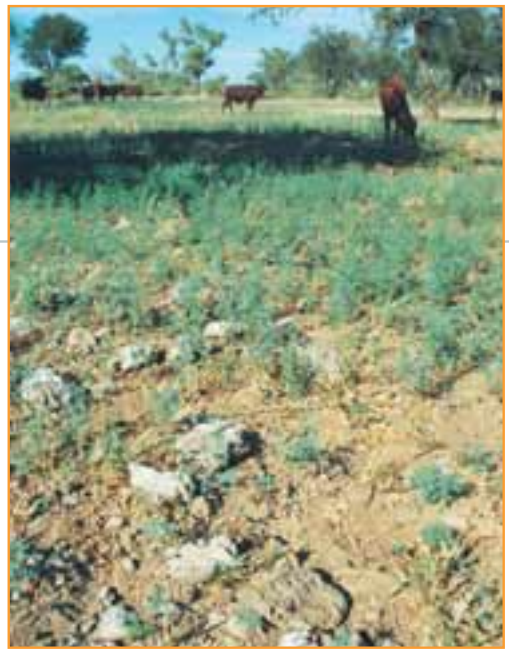
Seeds are finally deposited in the dung. In some animals, such as cattle, this is moist and nutrient-rich—providing an ideal microclimate for seedling emergence. Overall though, all animals that consume mesquite pods and pass viable seeds in their dung are capable of dispersing mesquite. In fact, the largest infestation in Australia, at Mardie Station in the Pilbara, spread when the property was running sheep, a relatively poor vector of mesquite seed.

Mesquite pods also float and can therefore be effectively spread by floodwater. Fortunately, the presence of pods is generally rare because of predation by animals. However, spectacular spread has been observed after flood events that coincided with peak pod fall.

Long-distance dispersal that results in new outbreaks is generally the result of human activity—for example, from intentional planting, attachment of seeds to machinery, or stock movement.



Seedlings sprouting from cattle manure.



Seed dormancy and seed-bank longevity

Mesquite seeds have hard-seeded dormancy, which means that the hard seed coat needs to be damaged (physically, mechanically or chemically) before the seed can absorb water and germinate. Seeds can remain dormant indefinitely if kept free of predators and stored in a dry environment at moderate temperatures. However, under natural conditions, they are intermittently exposed to hot and wet conditions. After favourable rainfall, seed burial trials have found that the majority of seeds will lose dormancy within two to three years, although dormant seeds can still be present after 10 years. As seed densities in the soil can be very high, the potential for a small portion to remain viable for more than 10 years means that sites where plants have been controlled will need to be revisited regularly if reinfestation is to be prevented.

Once seeds lose dormancy, all they require is enough water for germination. This generally occurs after significant rainfall in late spring and summer, although it can happen all year round. Dormancy, therefore, ensures that not all seeds germinate after just one rainfall event, thereby increasing the likelihood of seedling survival.

When will population explosions occur?

Mesquite is so well adapted to arid conditions that populations in Australia can continue to expand even under drought conditions. However, major population explosions occur after significant rain events. Optimal conditions are high summer rainfall to germinate the seeds, and good follow-up rain within several weeks of germination to ensure high seedling survival to the robust juvenile stage; however, massive recruitment can occur even after a single significant (e.g. cyclonic) rainfall event.

Some of the most spectacular population explosions have occurred as a result of record rainfall years that may occur only several times a century in any one place. High rainfall can result in seed spread across flood plains, high seedling survival and rapid growth.

Once established, seedlings are very resilient, and studies on some species have found that even after two weeks they can survive top-removal. Long-lived adult plants ensure that populations bridge the gaps between major recruitment periods.

Differences between mesquite species

The mesquite species in Australia have different distributions, growth habits and responses to management. To properly appreciate the potential threat each poses to the Australian environment, and to optimise their management, it will be necessary to develop a better understanding of their differing biology.

In summary, the key features of mesquite that contribute to its weediness are that:

- adults are exceedingly long-lived
- plants can adapt to survive drought conditions
- seed banks are relatively long-lived
- seeds are adapted to dispersal by a wide range of herbivores
- seedlings are tough.

History of spread

Throughout the early 1900s, mesquite was widely planted on properties throughout northern Australia—around homesteads as a shade tree, and in paddocks for shelter and as a possible food source for stock. It was also grown as an ornamental tree in town gardens.

Mesquite was planted around mining sites in the Cloncurry area of Queensland as it was thought to be a good soil stabiliser (Jeffrey & March 1995). Around the mining areas of Broken Hill in New South Wales it was used to reduce dust and erosion (Cunningham et al. 1992).

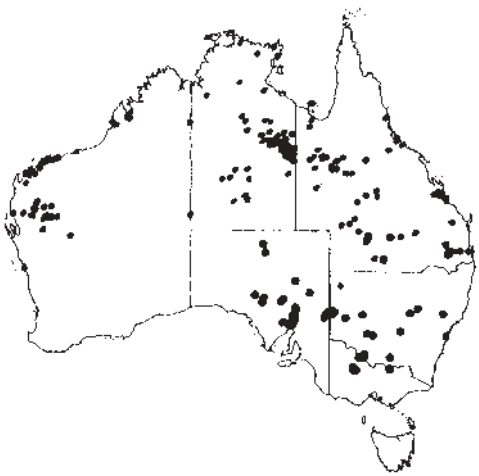
By the 1920s and 1930s, it was widely distributed throughout Queensland, the Northern Territory and Western Australia. Its introduction into other states was scattered and varied (van Klinken & Campbell 2001).

Initially, plants showed little tendency to spread, and it was not until after the 1945 floods in Western Australia that the weediness potential of mesquite became evident. A couple of trees planted in the 1930s around the homestead and shearing shed at Mardie Station (WA) rapidly multiplied, resulting in the largest and worst mesquite infestation in the

country. The infestation currently stands at 30 000 ha of dense mesquite, and 120 000 ha of scattered plants.

Similarly, the infestation in Quilpie, Queensland started from a couple of shrubs planted around a homestead. After significant rainfall events in the 1950s, mesquite spread to a nearby lake, and plants are now scattered over approximately 300 000 ha of land in south-west Queensland, with a core infestation of 4000 ha.

Most, if not all, of the main mesquite infestations have derived from plantings of a small number of trees (van Klinken & Campbell 2001).



▲ Map showing location of all recorded mesquite in Australia. [Information based on maps in van Klinken and Campbell 2001]

Current distribution

Mesquite has naturalised in every state and territory of Australia, with the exception of Tasmania and the Australian Capital Territory.

Prosopis pallida

Prosopis pallida occurs in scattered infestations throughout Queensland, Western Australia and the Northern Territory, with most infestations occurring in north-west Queensland. Major infestations occur in the Cloncurry and Hughenden areas; however, control work has reduced the size of these infestations.

Scattered *P. pallida* occurs in Western Australia, mostly in patches in the Pilbara and western Kimberley regions.

In the Northern Territory, scattered infestations occur mainly throughout the Barkly Tableland. Control programs by both government and landowners have dramatically reduced the size of these infestations.

P. velutina and *P. velutina* x *P. glandulosa torreyana* hybrids

Major infestations of *P. velutina*, and *P. velutina* x *P. glandulosa torreyana* hybrids occur along the Bulloo River in south-west Queensland, with the largest infestation occurring north of Quilpie. There are scattered plants along the flood plains of the Warrego River near Cunnamulla, and an isolated infestation on the Bulloo Lakes. Control efforts by landowners, and local and state governments have reduced the spread of this infestation.

Infestations in New South Wales are mostly scattered throughout the Milparinka and Broken Hill areas and cover approximately 27 000 ha. Control work in the 1980s killed all mature trees in these areas; however, owing to a lack of follow-up, mesquite has regenerated. Isolated plants have also been found in the south-western Riverina district and in the north-western areas of Gilgandra, Coonable and Bourke.

In South Australia, infestations have been recorded in the Woomera and Port Augusta regions. As a result of control work, these infestations have been reduced to isolated trees.

Victoria has had two small infestations, thought to be *P. velutina*, in Swan Hill and Wangaratta in the north of the state. These infestations have been treated; however, the current condition is unknown.

P. glandulosa var. *glandulosa*

The largest infestation of approximately 1000 plants of *P. glandulosa* var. *glandulosa* occurs in the eastern Kimberley region. Smaller isolated infestations occur in New South Wales and in the Rockhampton area of Queensland. Treatment of these infestations has reduced them dramatically.

P. juliflora

P. juliflora is the least common species of mesquite found in Australia. There has been confusion as to its identification and, to date, there have been only two confirmed recordings—one at Geraldton in Western Australia and one at Townsville in Queensland. The latter has been controlled.

Hybrids

The range of species compositions means that plant form and features may vary within and between plants and infestations—technically these features are referred to as different morphotypes.

Hybrid infestations occur in north-west Queensland around the McKinlay area, but are most widely distributed in Western Australia. The largest is on Mardie Station in the Pilbara region. Other scattered light infestations occur on stations south of Derby, Broome and Kununurra. There are also patches of mesquite in the Gascoyne region of the state.

The problem

Mesquite has the potential to become a serious and widespread pastoral and environmental weed in Australia (Csurhes 1996). Although sparse stands may provide shade and shelter for stock, impenetrable thickets can form over time—the threat posed by mesquite far outweighs any benefits that the plant may have.

Infestations commonly begin along watercourses (natural and constructed), but plants will do just as well away from water. Mesquite is an aggressive competitor in rangeland situations and will rapidly invade upland country. Some infestations, such as those in McKinlay and Cloncurry, Queensland, have had no relationship with water (S Campbell 2003, pers. comm., 1 March). However, any limited distribution along watercourses is typical of the early phases of invasion and should be considered a warning (Csurhes 1996).

Mesquite can have a dramatic impact on primary production and the environment. If uncontrolled, the plant will continue to spread at an increasingly rapid rate.

Direct effects of mesquite on landholders include:

- reduced pasture and loss of production
- increased financial costs—prickly acacia currently costs landholders more than $5 million per year in lost production, control costs and increased management costs. Mesquite has the potential to be as bad a pest, if not worse, than prickly acacia, (E Miller 2003, pers. comm., 3 March)
- increased difficulty and expense in mustering stock
- damage to infrastructure if weeds are growing along fence lines and watering points—thorns can also damage vehicles by puncturing tyres and damaging paint work

- increased medical expenses—currently about $20 000 per year is spent on medical treatment for problems caused by the thorns of the prickle bushes (E Miller 2003, pers. comm., 3 March).

The environmental effects of mesquite include:

- increased land degradation and loss of soil moisture due to their extensive and deep root system
- loss of biodiversity—mesquite competes with and takes over native vegetation, causing a change in habitat
- provision of refuges for feral animal populations
- damage to environmentally sensitive areas such as watercourses.

As weed populations tend to increase more rapidly over time, control becomes more difficult and costly. The Department of Natural Resources and Mines has already spent millions of dollars in attempting to eradicate mesquite and prevent it from becoming a major pest in Queensland (E Miller 2003, pers. comm., 3 March). Though this work has reduced the rate of spread, mesquite continues to be a problem.

Although control costs can initially be high for landholders, the benefits gained in the long term far outweigh this. The Australian Agricultural Company demonstrated that the weed control program for their Gulf stations would provide a reasonable rate of return of 12–13% on the funds invested into weed control over a 20-year period (J White 2003, pers. comm., 20 February).

Potential threat

All Australian mainland states and territories have favourable climatic conditions for the growth of all species and hybrids of mesquite, which is generally adapted to hot and dry conditions, and grows well in a diverse range of soil types (van Klinken & Campbell 2001).

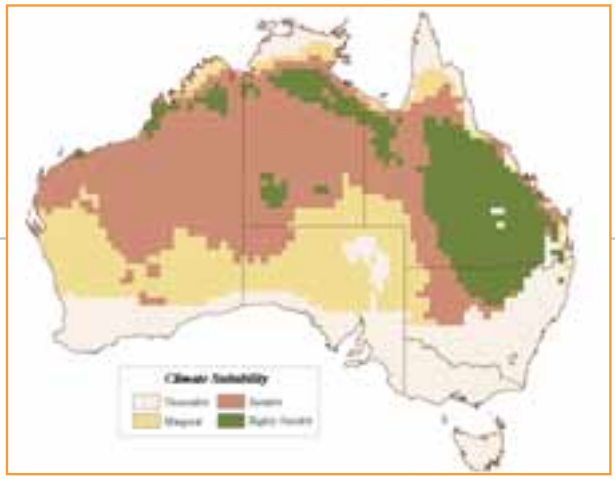
Exceptions are areas of very high rainfall such as Darwin, and areas of extreme frost and cold such as southern Victoria.

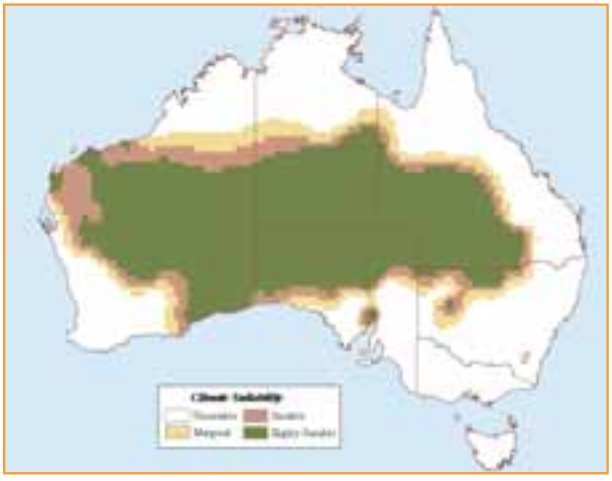
The semi-arid and arid regions of the country are most at risk of invasion by mesquite. *P. pallida* is mostly suited to northern areas of the country, with distribution likely to be limited in the south by cold stress and severe frosts.

The species *P. glandulosa* and *P. velutina* are more tolerant of colder climates and will also do well in cooler areas, such as western New South Wales.

Potential distribution of mesquite in Australia

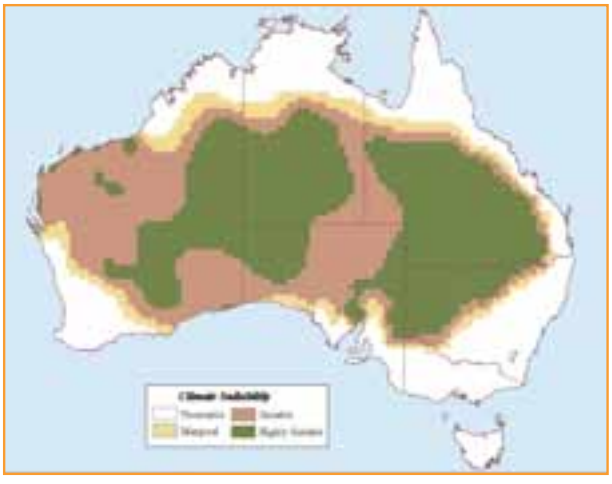
a) *Prosopis pallida*





b) *Prosopis velutina*

c) *Prosopis glandulosa* var. *torreyana*



Potential distribution data is based on CLIMEX information
[Note] As there are many varieties of mesquite hybrids, they have not been mapped. All major hybrid varieties are a combination of the three major species mapped and potential distribution is likely to be in similar areas to those already indicated.