

State Opuntoid Cacti Management Plan



**Government
of South Australia**

Biosecurity SA

State Opuntoid Cacti Management Plan

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FOR

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State Opuntoid Cacti Management Plan

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Acronyms

ALIS	Arid Lands Information System
APVMA	Australian Pesticides and Veterinary Medicine Authority
BPPPG	Blinman Parachilna Pest Plant Group
DEH	Department for Environment and Heritage
ESRI	Environmental Systems Research Institute
GIS	Geographical Information System
GPS	Global Positioning System
MSMA	Monosodium methylarsonate
S7	Schedule 7 poison
SAAL	South Australian Arid Lands
SA MDB	South Australian Murray Darling Basin
SAMRIC	South Australian Murray Darling Basin Resource Information Centre

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Executive Summary

Opuntia species and other opuntoid cacti originated from the Americas and have been present in South Australia for more than 150 years. These cacti are particularly well-adapted to semiarid climates, and are known to survive in areas receiving an annual rainfall of 150 mm.

This plan intends to summarise the current management options and identify a range of goals, objectives and actions which will aid in the future management of opuntoid cactus species within South Australia.

Acknowledgments

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1 Introduction

The term 'opuntioid cacti' is here used to include numerous species of 'prickly pears' and similar cacti in the subfamily Opuntioideae of the Cactaceae. Originating from the Americas, species of *Opuntia* and related genera have been present in South Australia for more than 150 years (Kloot, 1986). Many species were introduced as amenity plantings e.g. garden ornamentals and hedges, while other species have been introduced as food plants.

Species like common pest pear (*O. stricta*), drooping prickly pear (*O. monacantha*), devil's rope cactus (*O. imbricata*) and wheel cactus (*O. robusta*) have spread and are impacting on the environmental, economic and social assets of South Australia.

This plan intends to summarise the current management options and identify a range of goals, objectives and actions which will aid in the future management of opuntioid cactus species within South Australia. It is recommended that this plan be reviewed and updated every 3 years to capture changes in distribution, management and policy.

2 Vision

State NRM Plan Goal 4:
Integrated management of biological threats to minimise risks to natural systems, communities and industry.

The vision for opuntioid cactus management within South Australia is:

A healthy landscape that benefits biodiversity while sustaining multiple industries

3 Key outcomes

The following outcomes have been specified as steps towards meeting the desired vision for opuntioid cactus management in South Australia

Outcome 1: Opuntioid cactus species are effectively managed across the State

Outcome 2: Land managers are informed and actively involved in opuntioid cacti management

These outcomes imply that all relevant stakeholders are engaged, best practice management techniques are being utilised, and opuntioid cactus infestations are being managed strategically. Specific actions and responsibilities to meet these outcomes are detailed in Section 8.

4 Development of plan - process followed

This plan was instigated by the former Department of Water, Land and Biodiversity Conservation (DWLBC) through the successful application for funding through the 2008/09 Complementary State NRM Program.

The application included

- The convening of a State opuntioid cacti management workshop
- The preparation of a management plan, for incorporation in the revised State level policy on opuntioid cacti.

The State Opuntia management workshop was held in Port Augusta on the 5th May 2009. Attendees of the workshop included representatives of state agencies (DWLBC, DEH), regional bodies (NRM Boards), community action groups (BPPPG) and local landholders.

Regional overviews were sought to gain an understanding of the present management being undertaken on opuntioid cacti across South Australia.

To aid in defining the issues surrounding management of opuntioid cacti in South Australia, the workshop participants were asked a series of questions;

- What are we trying to protect?
- What are we doing well?
- What can we do to improve?
- What do we need?
- What will stop us from being successful?

Discussion on current methods of control and current regional programs was also undertaken on the day.

Outcomes of the workshop centred on four key areas:

- Management of opuntioid cacti
- Education and awareness
- Funding
- Involvement

The outcomes from the questions and discussion have been utilised in the preparation of this management plan.

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5 Background

Plants commonly known as prickly pears were formerly treated as the genus *Opuntia*. They are now regarded as several genera within the subfamily Opuntioideae. This genus is now treated as the subfamily Opuntioideae with 200 or more species divided among *Opuntia* and 15 other segregate genera such as *Austrocylindropuntia* and *Cylindropuntia*. In this document they are called simply “opuntioid cacti”.

Twenty five species of opuntioid cacti have been identified in South Australia, but the major weedy species include the common pest pear (*Opuntia stricta*), drooping prickly pear (*Opuntia monacantha*), devil’s rope cactus (*Cylindropuntia imbricata*) and wheel cactus (*Opuntia robusta*).

5.1 Biology

Opuntioid cacti can vary from low-growing, almost prostrate specimens to 60 cm high (*O. aurantiaca*), to erect, tall, multi-stemmed shrubs to 5 metres (*O. monacantha*) (Greenfield 2007). These cacti are particularly well-adapted to arid areas, and are known to survive in areas receiving an annual rainfall of 150 mm (Parsons & Cuthbertson 2001). They do not appear to have strong association with any particular soil type (Greenfield 2007).

Opuntioid cacti have a series of thick and fleshy cladodes (stems which perform the function of leaves) (Fig. 1). Depending on the species, they may appear as wide pads or as a series of elongated stems, rope-like in appearance (Greenfield 2007). Detached cladodes are known to survive for at least three years (Parsons & Cuthbertson 2001), and anecdotal evidence suggests that they may even survive long periods of solarisation.



Figure 1. *O. robusta*, R. Chinnock

Areoles (buds that usually bear clusters of spines) are found on both the pads (joints, segments) and fruit. In addition to spines, areoles bear clusters of sharp bristles called glochids and may also have tufts of fibre called “wool”. Each areole

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contains a dormant growing point that can produce roots or shoots when in contact with the soil (Biosecurity Queensland 2007).

Flowers range in colour depending on the species, from bright yellow for *O. stricta* and *O. robusta* (Figures 1 & 2) to reddish purple for *Cylindropuntia imbricata*. The fruit are red to reddish purple; vary from pear shaped to almost spherical, with numerous seeds imbedded in the pulp within the fruit. *O. stricta* and *O. robusta* fruits develop from December, maturing and dropping by March or April (Parsons and Cuthbertson 2001).



Figure. 2. *O. stricta*, L. Edmunds

Large quantities of viable seed are produced in the fleshy and palatable fruit. Seeds are thought to remain viable for up to 20 years (Parsons & Cuthbertson 2001), while areoles may remain viable on detached cladodes for up to a couple of years. The fruits of opuntoid cacti are readily consumed and seeds are then spread and deposited in droppings of birds including emus, as well as foxes, cattle, goats and sheep. Segments or pads can easily break off and be carried in flood water, on machinery, animals, clothing and footwear.

The mechanism for CAM photosynthesis of opuntoid cacti provides a particularly competitive advantage over many other species. Plants with crassulacean acid metabolism (CAM) have the ability to capture and store CO₂ during the night and then photosynthesise during daylight, when their stomata are closed. This strategy reduces water loss, increases light and temperature tolerances, and yields greater net photosynthesis efficiency. Plants using the CAM mechanism for photosynthesis are consequently well adapted to arid conditions.

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Table 1 lists all the current species of opuntoid cacti presently known in South Australia.

Table 1. List of current opuntoid cacti for all regions of South Australia.

Adapted from the Census of South Australia Plants, Algae and Fungi, produced by the State Herbarium of South Australia, as of 19/12/2006 (with additional information from Bob Chinnock, 13/02/2009).

Austrocylindropuntia		
<i>Austrocylindropuntia cylindrica</i>	cane cactus	FR* EP* MU* SL*
<i>Austrocylindropuntia subulata</i>		FR* EP* NL* MU*
Cylindropuntia		
<i>Cylindropuntia fulgida</i> var. <i>mamillata</i>	coral cactus	GT* FR* EA* EP*
<i>Cylindropuntia imbricata</i>	devil's rope pear	GT* FR* EP* NL* MU* SL*
<i>Cylindropuntia kleiniae</i>		MU?*
<i>Cylindropuntia prolifera</i>	jumping cholla	FR EP
<i>Cylindropuntia rosea</i>	Hudson pear	FR* EP* MU*
<i>Cylindropuntia spinosior</i>		FR* MU*
<i>Cylindropuntia tunicata</i>		MU*
Opuntia		
<i>Opuntia aurantiaca</i>	tiger pear	NL*
<i>Opuntia elata</i>		GT* EP* MU* SL* SE*
<i>Opuntia elatior</i>		GT* FR* EA* EP* MU* YP*
<i>Opuntia engelmannii</i> var. <i>cuija</i>		GT FR EA EP MU*
<i>Opuntia ficus-indica</i>	Indian fig	GT* FR* EP* NL* MU* SL*
<i>Opuntia microdasys</i>	teddy-bear cactus	FR* EP* MU*
<i>Opuntia monacantha</i>	smooth tree pear	GT* EA* EP* MU* SL*
<i>Opuntia polyacantha</i> var. <i>erinacea</i>		EP* MU* SL*
<i>Opuntia polyacantha</i> var. <i>hystricina</i>		FR*
<i>Opuntia puberula</i>		FR* EP* NL* MU* SL* SE*
<i>Opuntia robusta</i>	wheel cactus	FR* EA* EP* NL* MU* YP*
<i>Opuntia stricta</i>	common pest pear	GT* FR* EP* NL* MU* YP* SL*
<i>Opuntia sulphurea</i>		GT
<i>Opuntia tomentosa</i>	velvety tree pear	FR* EP* MU* SL*

*Suffix – indicates a naturalised plant

?*Suffix – indicates that it is questionably in the region

Regions

EA	Eastern	EP	Eyre Peninsula	KI	Kangaroo Island
FR	Flinders Ranges	GT	Gairdner-Torrens	MU	Murray
NL	Northern Lofty	LE	Lake Eyre	NU	Nullarbor
SE	South-Eastern	NW	North-Western	YP	York Peninsula
		SL	Southern Lofty		

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5.2 Distribution

Major infestations of *Opuntia robusta* and *O. stricta* occur near Peterborough, Terowie, along the River Murray cliffs, in the Blinman Parachilna area of the Flinders Ranges and around Port Augusta.

The State Opuntia Taskforce commissioned the collation of opuntioid cacti data from across the state. A request was made to each NRM region by phone and follow-up email for location information of any Cactaceae species listed in table 1 in any form, providing it could be converted into a spatial dataset. Location information requested included:

- Digital records (ESRI shapefiles)
- Spreadsheets of GPS coordinates
- Locations sketched on a map and faxed or emailed
- Written or verbal descriptions that can be digitised into a spatial database

The additional attributes were also requested:

- Species
- Size of infestation
- Density
- Control works/action undertaken

While this is not a complete account of all known opuntioid cactus infestations, it does provide base level data which can be improved and refined into the future.

Figure 5.1 below illustrates the distribution of opuntioid cacti species within South Australia. It is noted that although the records available from Eyre Peninsula at time of writing were concentrated on the eastern side of this region, opuntioid cacti also occur scattered across the region.

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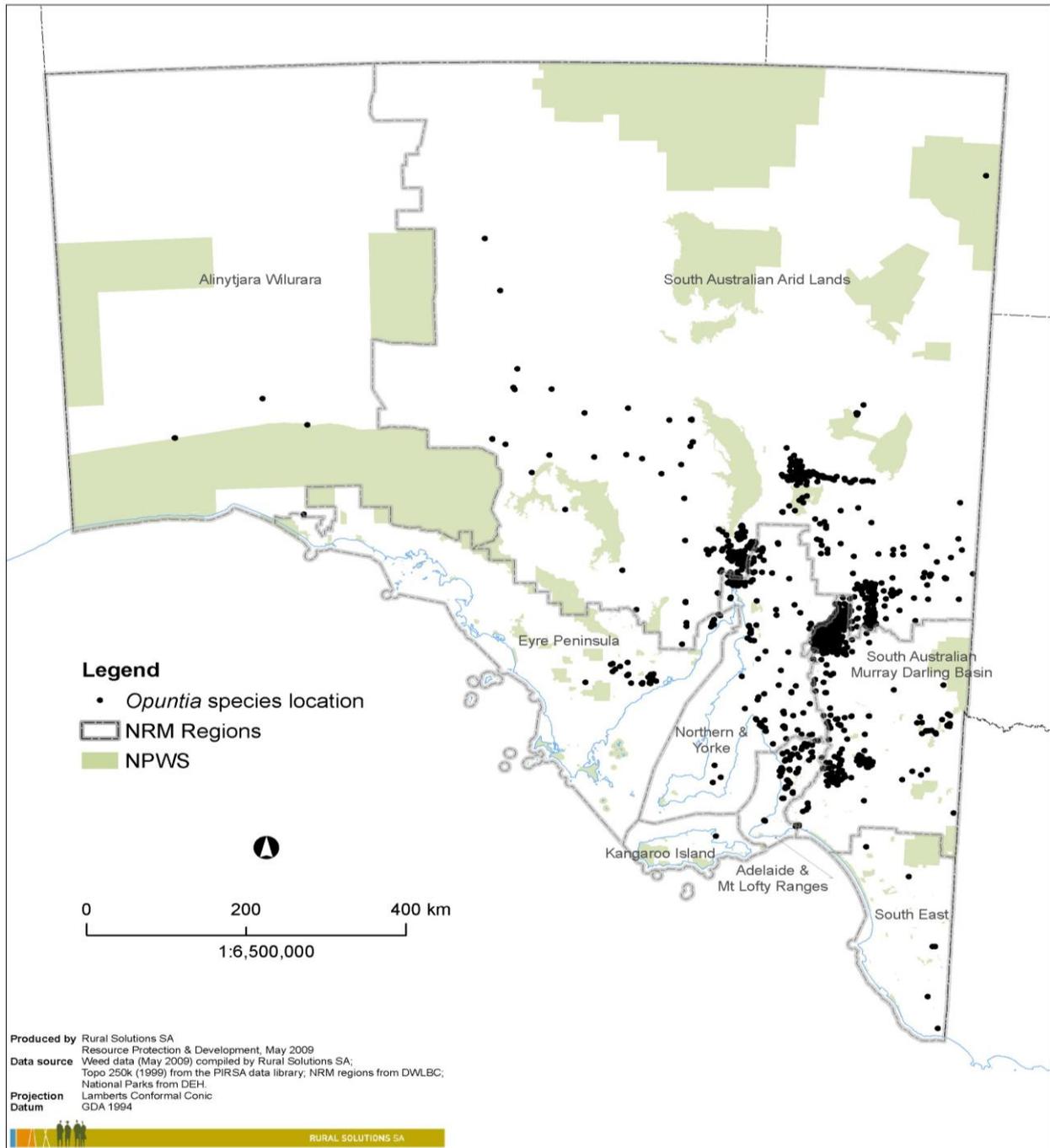


Figure 5.1. State distribution of Opuntioid cacti

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5.2.1 Area of opuntoid cacti in South Australia

The collation of records from the various agencies and individuals indicate that over 932,000 ha of land are impacted upon by opuntoid cacti. The largest infested areas are in the SAAL and NY regions.

Table 2: Area of opuntoid cacti in South Australia

	NRM Region								Total
	AMLR	AW	EP	KI	NY	SAAL	SAMDB	SE	
Point	0.0075	0.0008	0.2000	0.0001	0.0464	0.0247	0.0366	0.0006	0.3867
Line	0.0477	-	-	-	0.0156	0.3710	1.6894	-	2.1237
Polygon	-	-	200	-	217,735	687,300	27,114	-	932,340

All figures are in hectares; 1 ha = 10,000 square metres.

Assumes point features are 1 sq m each (i.e. 75 points = 75 sq m or 0.0075 ha); these contribute less than 1 ha to the total

Assumes line features are 1 metre wide; these contribute less than 3 ha to the total

Virtually all of the infested area was estimated from GIS map polygons circumscribing cactus infestations, whose density is variable across the areas indicated in the table.

5.2.2 Potential Distribution

The potential distribution of *Opuntia stricta* in grazing lands of the southern agricultural region (figure 5.2) and native vegetation areas (figure 5.3) of South Australia was modelled with available information in 2005. These maps were produced by overlaying the results of a 'CLIMATE' modelling analysis with each of the two selected land uses, while removing areas poor drained soils. It is recommended that a similar analysis is undertaken for the other opuntoid cacti presently found within South Australia or close to the State's borders.

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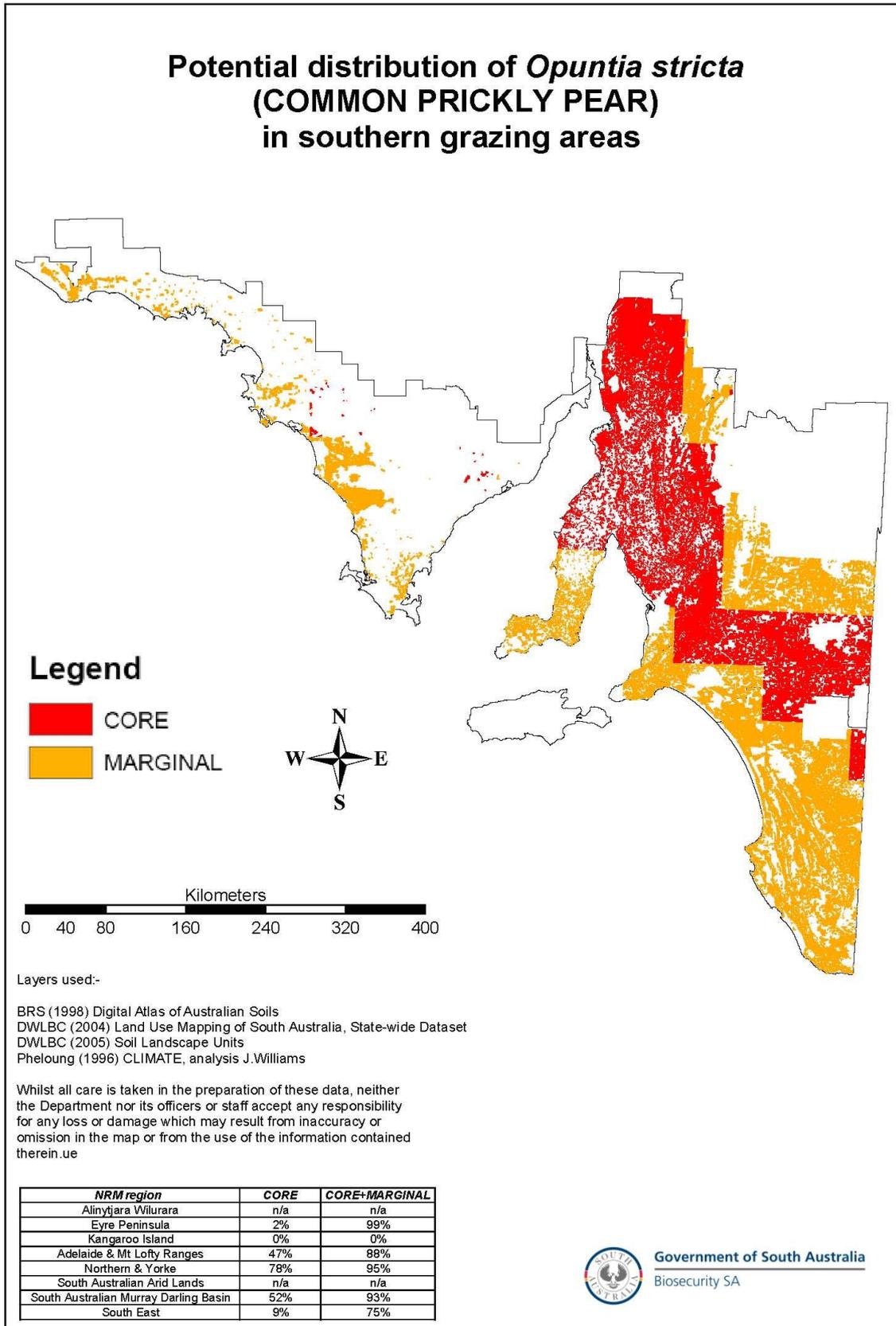


Figure 5.2. Potential distribution of *O. stricta* within southern grazing regions

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Potential distribution of *Opuntia stricta* (COMMON PRICKLY PEAR) in native vegetation* of South Australian NRM regions.

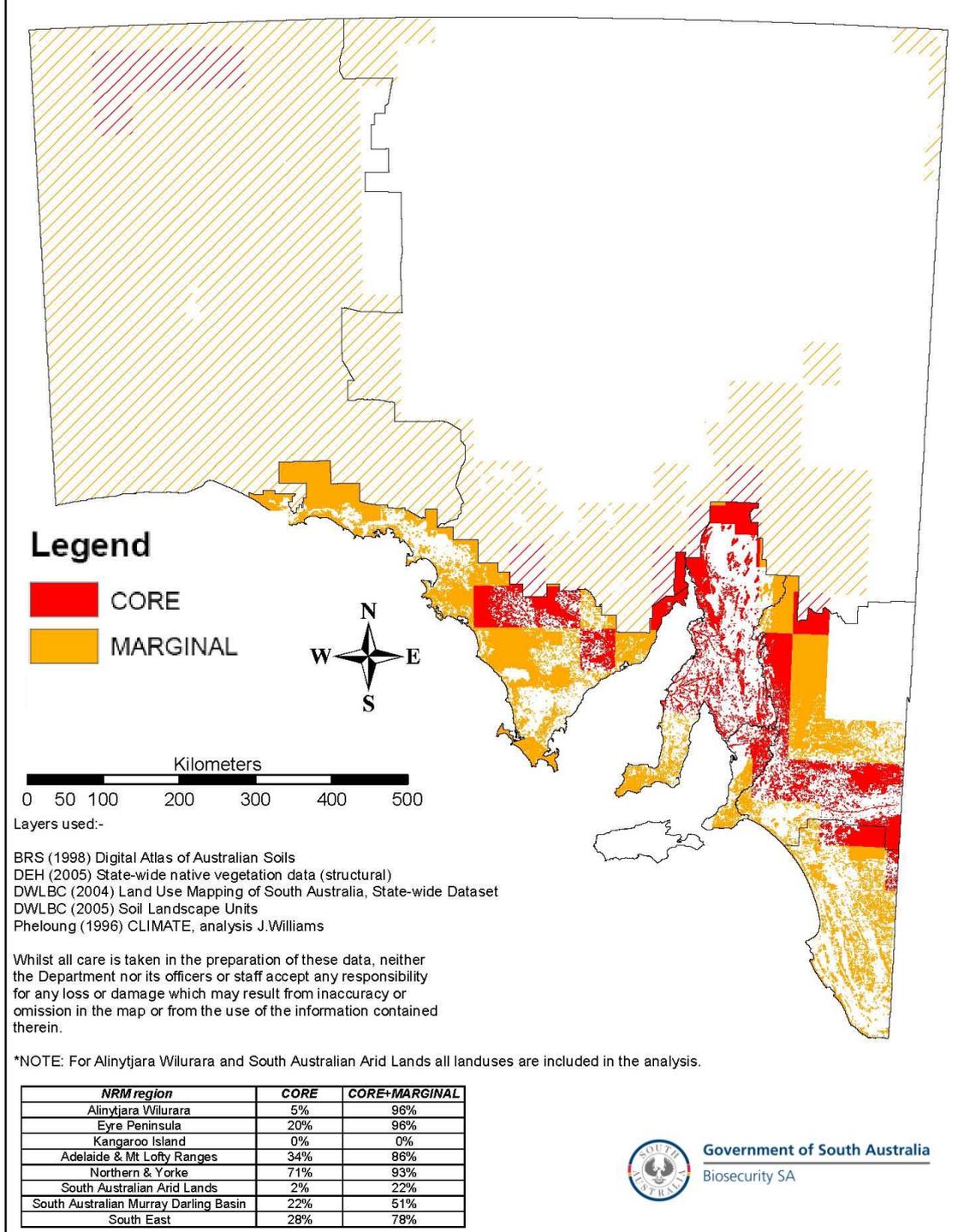


Figure 5.3. Potential distribution of *O. stricta* within native vegetation

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5.2.3 Potential distribution under a climate change scenario

The impact of climate change on *Opuntia robusta* was estimated by Kriticos et al. 2009, who stated

“Under the 2080 climate scenario, the state-wide risk for this species would shift southward as the climate suitability increases in the south and southeast of South Australia. It is likely that there are outlying populations to the south of those populations identified in figure 4. Under the future climate scenarios, these populations are likely to transform from benign populations to invasive as temperatures become more conducive for growth and reproduction.”

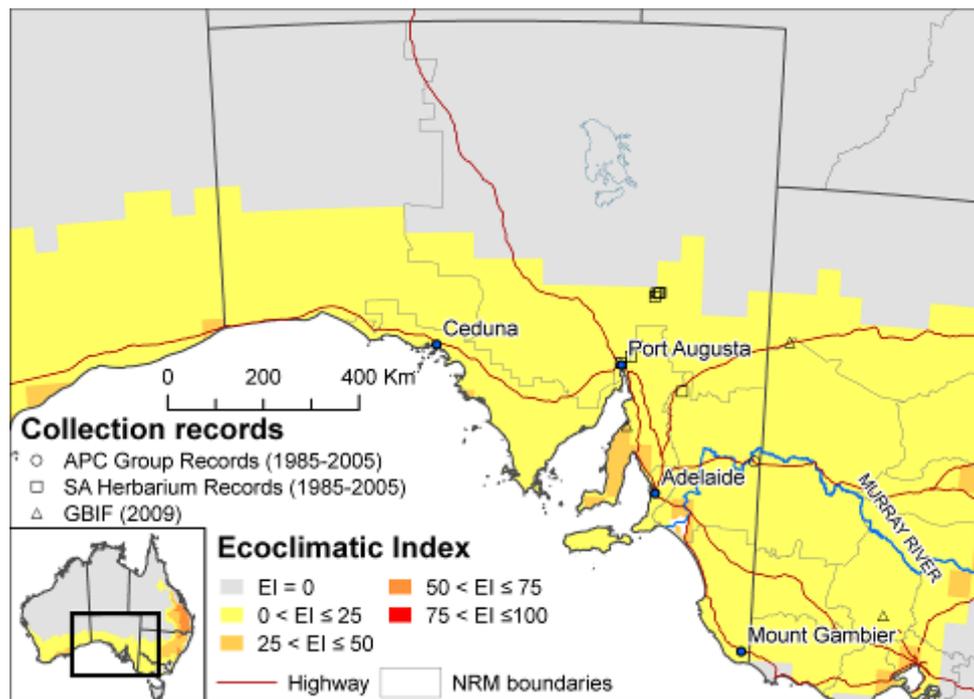


Figure 5.4. Historical climate suitability for *Opuntia robusta* in South Australia

As indicated by the CLIMEX Ecoclimatic Index (EI) using climate averages at 0.5 degree resolution from 1961–1990 (Mitchell et al. 2004). The CLIMEX model for *Opuntia robusta* was developed by Darren Kriticos (CSIRO, unpub. data).

Kriticos et al. 2009 also made the following recommendations for *Opuntia robusta*, which are consistent with the objectives and actions proposed in this management plan.

“Management options for the future are:

- Establish containment lines west of Port Augusta, and south of present distribution.
- Maintain current control efforts in the Flinders Ranges. Management of the weed in this area should become easier in the future as lower climate suitability slows population growth.
- Eradicate outliers, trying to increase the protected zone.
- Treat *Opuntia/Cylindropuntia/Austrocylindropuntia* species as a collective group for management. It is highly likely that most of the species in this group will respond similarly to both the effects of climate change, and also to management.”

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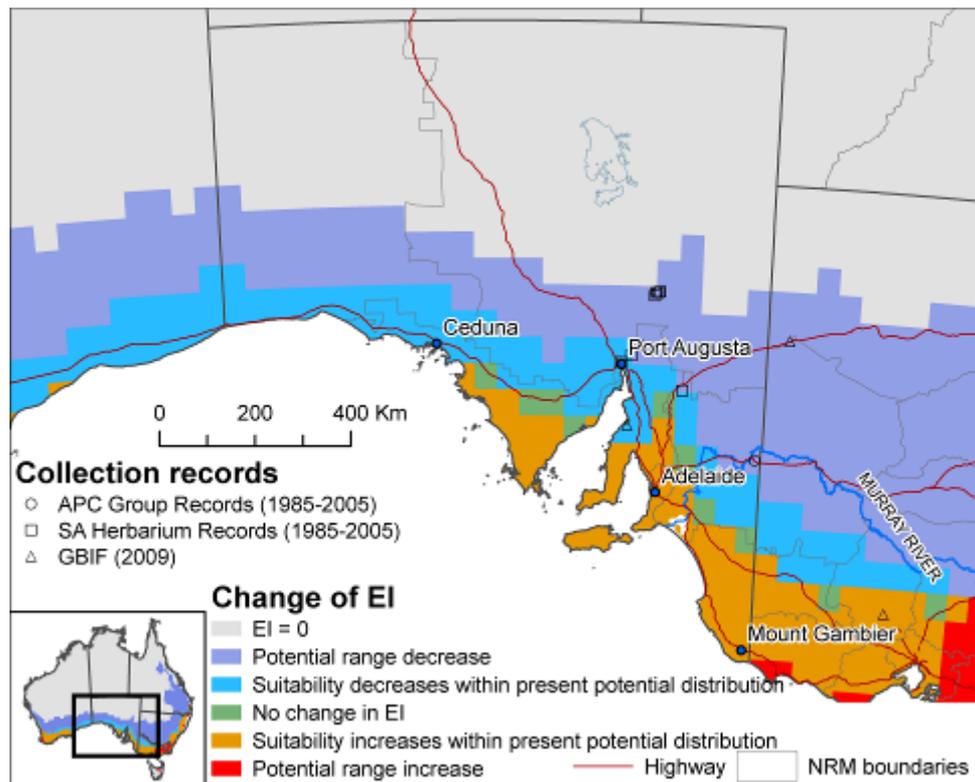


Figure 5.5. Change in climate suitability for *Opuntia robusta* in South Australia

As indicated by the CLIMEX Ecoclimatic Index (EI) using CSIRO Mk3 projections for 2080 based on the A1B SRES emissions scenario.

5.3 Impacts and uses

The presence of opuntioid cactus species can have financial, environmental and social impacts. Opuntioid cacti impact on pastoral enterprises through injury to stock, and difficulties in mustering in infested areas. High densities of opuntioid cacti can render land completely unsuitable for grazing. Opuntioid cacti can also contaminate wool and cause damage to hides. Infestations can harbour pests like fruit fly, and provide shelter for foxes and rabbits, which can be detrimental to production systems and industries other than pastoral grazing. In the Flinders Ranges area, control costs per plant have been estimated at \$4.50, which includes contractor labour, herbicides and equipment (Edmunds 2006).

Opuntioid cacti can reduce biodiversity and the health of endemic species through competition, including areas that support endangered species such as the yellow footed rock wallaby. Infestations of opuntioid cacti also significantly degrade the aesthetic values of landscapes, affecting tourism use and values, especially in high visitation outback areas. The plants can also cause injury to people, and especially shearers handling stock from the sharp spines and barbed bristles.

In their region of origin, *Opuntia* species are considered a valuable resource. The fruits (known as tunas, nopales or Indian figs) are eaten, and the cladodes may be cooked as vegetables. The plants are used as fodder for stock and as hedging and fences. Many plants were planted for their ornamental use in SA, and the cochineal insect is a source for the production of carmine dye.

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5.4 History of control and spread

The first plants of prickly pear species were brought into Australia on the First Fleet (Tanner, 2006b). Common pest pear was first recorded as being cultivated for stock fodder in the Parramatta district of NSW in the early 1800's (Tanner, 2006b).

After the introduction and widespread planting of *Opuntia* species in Australia throughout the 1800's, an exponential increase in abundance and distribution of *O. stricta* was observed. Four million hectares of Queensland was infested with prickly pear by 1900, and by 1926, 24 million hectares was infested (Parsons and Cuthbertson 2001). It was estimated that some 12 million hectares of previously productive land was completely removed from productivity for 10-15 years during this time. At the peak of the infestation, it is estimated that prickly pear was spreading at the rate of 100 hectares an hour (Parsons and Cuthbertson 2001). A highly successful biological control agent, *Cactoblastis cactorum*, a stem boring moth was introduced, which achieved a 90% mortality of prickly pear between 1925 and 1933 (Parsons and Cuthbertson 2001).

Various species of a cochineal mealy bug, *Dactylopius* spp., have also been introduced and can be effective in controlling common pest pear (*Opuntia stricta*), drooping prickly pear (*Opuntia monacantha*), and devil's rope cactus (*Cylindropuntia imbricata*) but less effective in controlling (*Opuntia robusta*), wheel cactus.

There is a long history of opuntoid cactus control in SA, and a range of methodologies have been trialled. Mechanical control, herbicides and bio-control agents have all been utilised, with current best practice discussed in section 6. The SAAL NRM Board has been active in opuntoid cacti management and has produced an *Opuntia* Management Plan (Greenfield 2007) and commissioned property surveys for opuntoid cacti in 2008 (see report by Willing 2008).

5.5 Risk Assessment

Risk assessments have been undertaken at both State and Regional level using the Biosecurity SA Weed Risk Assessment protocol (DWLBC 2009), in which explanation of the 'Weed risk' and 'Feasibility' scores and Actions may be found. The results for wheel cactus, *Opuntia robusta*, and devil's rope, *Cylindropuntia imbricata*, are summarised below.

Viewed over the whole State, the assessment implies low to medium risks because only certain areas of native vegetation are affected. However, at the scale of bioregions such as the Broken Hill Complex and Flinders Olary both weed risk and feasibility of containment may be very high.

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State Level

Opuntia robusta

Land use	Weed risk	Feasibility	Action
Native vegetation	Low 19	High 18	Monitor
Grazing - Rangelands	Medium 44	High 18	Protect sites
Grazing - Southern	Low 28	Very high 10	Protect Sites
Urban	Negligible 4	Very high 4	Monitor

Cylindropuntia imbricata

Land use	Weed risk	Feasibility	Action
Native vegetation	Low 14	High 18	Monitor
Grazing - Rangelands	Medium 39	Very high 13	Contain spread
Grazing - Southern	Low 22	High 15	Monitor
Urban	Negligible 4	Very high 4	Monitor

Alinytjara Wilurara (AW) Natural Resources Management Region

Species	Weed risk	Feasibility	Action
<i>Opuntia stricta</i>	High 154	Very high 0	Destroy
<i>Opuntia robusta</i>	Very High 232	Very high 0	Eradicate
<i>Cylindropuntia imbricata</i>	Medium 63	Very high 0	Contain spread

Regional level

South Australian Arid Lands (SAAL) Natural Resources Management Region

Opuntia stricta

Bio region	Weed risk	Feasibility	Action
Finke	Low	Very high	Protect Sites
Stony Plains	Medium	Very high	Protect Sites
Gawler	Medium	Low	Manage Sites
Flinders Olary	Medium	Low	Manage Sites
Broken Hill Complex	Medium	Very high	Contain spread

Opuntia robusta

Bio region	Weed risk	Feasibility	Action
Finke	Low	Very high	Protect Sites
Stony Plains	Medium	Very high	Protect Sites
Gawler	Very high	Very high	Eradicate
Flinders Olary	Very high	Negligible	Manage Weed
Broken Hill Complex	Very high	Very high	Eradicate

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Cylindropuntia prolifera & *C. rosea*

Bio region	Weed risk	Feasibility	Action
Finke			Alert
Stony Plains			Alert
Gawler	Very high	Very high	Eradicate
Flinders Olary	Very high	Very high	Eradicate
Broken Hill Complex			Alert

Northern & Yorke (N&Y) Natural Resources Management Region

Land use	Weed risk	Feasibility	Action
Native vegetation	Medium 98	Medium 48	Manage Sites
Grazing - Rangelands	Low 28	Very high 0	Contain spread
Urban	Negligible 4	Very high 0	Monitor

South Australian Murray-Darling Basin (SA MDB) Natural Resources Management Region

Opuntia robusta

Land use	Weed risk	Feasibility	Action
Native vegetation	High 114	Medium 40	Protect sites
Grazing - Rangelands	High 133	High 15	Contain spread
Urban	Low 28	Very high 8	Protect Sites

Cylindropuntia imbricata

Land use	Weed risk	Feasibility	Action
Native vegetation	Medium 56	Low 81	Manage sites
Grazing - Southern	Low 22	High 15	Monitor
Urban	Low 28	Very high 8	Protect Sites

5.6 Legislative requirements

Natural Resources Management Act 2004

Species of *Opuntia sens. lat.* including *Cylindropuntia* and *Austrocylindropuntia* are declared under the *Natural Resources Management Act 2004* for the whole of the State. The only exception is spineless *Opuntia ficus – indica*.

There are a number of sections applying to the management of these opuntoid cacti which allow the Natural Resource Management Boards to uphold certain measures. These include:

- 175(1)(2) Prohibiting movement on public roads and entry into SA.
- 177(1)(2) Prohibiting sale of the plants or their seeds, or contaminated material.

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- 182(1)(3) Requiring landowners to destroy the plant on their properties.
- 185(1) Allowing recovery of costs incurred by NRM authorities in undertaking control on road reserves.

The current state declared plant policy on prickly pear is included as Appendix A on p. 33.

Controlled Substances Act 1984

Various opuntoid cacti contain trace amounts of the psychoactive drug mescaline (Ma et al., 1986; Meyer et al., 1980). Current regulations under the *Controlled Substances Act 1984* prohibit the cultivation of any plant containing any amount of mescaline. Although no-one is going to grow these cacti for their minuscule drug content, this legislative technicality should be noted.

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6 Best practice management - current control options and issues

A search of the APVMA database in May 2009 revealed there are 54 registered products and 1 permit currently registered for the control of opuntoid cactus species but these products only span four active ingredients; picloram/triclopyr mixture, MSMA, triclopyr, and glyphosate.

Always follow safe use instructions on herbicide labels. Refer to product label for full conditions of use and application instructions. Some of the herbicides are soil active residuals and must be used with care to minimise damage to native vegetation.

These recommendations have been compiled from herbicide manufacturer labels. State Government and NRM Boards hold no responsibility for their effectiveness.

For specific advice on the use of these herbicides and recommendations please contact your local Natural Resources Management Board. In certain circumstances these recommendations may not be suitable.

Numerous control methods have been developed and trialled by NRM Boards and contractors. In the majority of cases either the foliar spray or stem/pad injection control techniques are being employed. Other management options exist for opuntoid cactus control, these are summarised in table 2 below.

Table 3: Management options for opuntoid cactus species.

Compiled by Kym Haebich (SA Murray-Darling Basin NRM Board).

Management Option	Description	Advantage	Disadvantage
Over-all Spray MSMA e.g. Daconate® Triclopyr e.g. Garlon® Picloram/Triclopyr e.g. Grazon®	Application of chemical, may be used with a surfactant e.g. Diesel, Pulse, BS1000 Cost \$\$	<ul style="list-style-type: none"> • Complete coverage of plants • No specialised equipment needed • Suited to large infestations and roadsides 	<ul style="list-style-type: none"> • Application of MSMA required over 30°C • Operator discomfort from working in high temperatures. • Hard on equipment • Potential for off target damage • S7 license required to purchase MSMA • Usually reliant on vehicle access • Frost and dry stress on plants will affect effectiveness

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<p><u>Stem/Pad Injection</u> This control method is conducted under APVMA permit PER9362 glyphosate MSMA</p>	<p>Injection of measured herbicide per m of stem or in every 4th pad utilising; 'Velpar®' gun and injecting lance Drill & Fill method Or pressurised 'banana spike"</p> <p>Cost \$\$</p>	<ul style="list-style-type: none"> • Suited to isolated, small infestations or difficult to access sites • Done at any time • Low volumes of chemical required • Can be undertaken by volunteer with minimal training and supervision. 	<ul style="list-style-type: none"> • Specialised equipment (injector gun, cordless drill, auger bit, banana spike) • S7 license required to purchase MSMA • May not be suitable for dense infestation
<p><u>Cut Stump</u></p>	<p>Application of undiluted herbicide directly onto the stump after cutting branches</p> <p>Cost \$\$</p>	<ul style="list-style-type: none"> • Effective for isolated plants • Minimal off-target damage to vegetation • Can be undertaken by anyone 	<ul style="list-style-type: none"> • Can cause new plants if plant material not disposed of correctly • Can miss some branches of plants
<p><u>Mechanical removal</u></p>	<p>Mulching, digging out with implement or machinery. Deep burial > 1m</p> <p>Cost \$\$\$</p> <p>Complete removal and destruction of plant by hi-speed tree chipper</p> <p>Cost \$\$\$</p>	<ul style="list-style-type: none"> • Removed from site • Effective for isolated individuals • No chemical required • Can be used at any time of the year , in any weather conditions • Plant is reduced to pulp and will not regenerate • Pulp may be used as mulch 	<ul style="list-style-type: none"> • Potential for spread • Weight of plants • Ineffective disposal could lead to new infestations • Not suitable for large infestations • Labour intensive • Site may not be suitable for burial • Labour intensive • High cost
<p><u>Burning</u></p>	<p>Place wood, straw or other combustible plant material around base of plant and burn.</p> <p>Cost \$</p>	<ul style="list-style-type: none"> • No chemical required 	<ul style="list-style-type: none"> • Off target damage • May require repeated treatment • Risk of fire escape
<p><u>Biological Control</u></p> <p>Presently <i>Cactoblastis cactorum</i> and some species of the cochineal mealy bug <i>Dactylopius</i> sp have been introduced.</p>	<p>Utilises natural control agents to decrease the density and abundance of a plant population</p> <p>Cost Initial research and testing \$\$\$\$\$ Once established \$</p>	<ul style="list-style-type: none"> • Suited to large or remote locations • Can be easily spread • Low cost if utilising current biological control agents 	<ul style="list-style-type: none"> • Host-specificity means that it is not be effective on all opuntoid cactus species • May not destroy all plants nor limit spread of infestations • High cost for research and testing

Under investigation is the use of *Cactoblastis doddi*, a native of Argentina, for the control of *O. robusta*, as the agent *C. cactorum* present in Australia is unsuited to the cool arid region in which most *O. robusta* infestations occur. A funding application to undertake the research has been instigated.

Since physical and financial resources are limited, defining priority areas for management to occur will aid in achieving the greatest benefit for the lowest cost. Priority sites will be defined by many factors some of which include:

- Density level (nil/low/medium/high)
- Distribution (isolated/ scattered/ widespread)
- Access
- Productivity

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- Presence of threatened animal and plant species or communities.
- High traffic / frequently visited areas.

Priority sites may include:

- Outlier populations.
- Creek lines, start at the head and work downstream.
- Hills and cliffs, if possible, start at the peak and work down.
- High priority asset sites (productivity, biodiversity, tourism).

Undertake control of core infestations last and always work from the edges in.

As seed remains viable for many years and broken-off cladodes may also live for a long period before taking root, monitoring and follow-up control actions are vital to achieve long-term control of opuntioid cacti (see section 9).

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7 Key stakeholders and roles

For the effective management of opuntoid cactus species across the State, the following stakeholders are integral in implementing the actions and strategies identified in this plan. Land managers are critical for the successful implementation of this plan. Without their involvement, opuntoid cactus species have the potential to dramatically increase their range and further cost the community. The specific roles for each stakeholder against the suggested actions of this plan are detailed in section 8.4.

Private landholders (Local)

Under provisions of the *Natural Resources Management Act 2004*, landholders are required to control and manage opuntoid cactus species on their own lands. This may include the;

- Development of property management plans,
- Implementation of best practice management,
- Eradication of strategically important infestations,
- Implementation of good hygiene practices to prevent spread,
- Ability to identify opuntoid cactus species.

Land managers and users have a role to;

- Detect and report new occurrences,
- Understand the impacts of opuntoid cactus species on their region's assets and support and promote sustainable practises to minimise these impacts,
- Apply their knowledge and skills to improve management and jointly plan and coordinate management activities with neighbours and community.
- Implement regional management strategies

Other landholders e.g. organisations such as DEH, DTEI, SA Water (Local)

With regards to weed control under the legislation, these organisations are landholders and thus have the same responsibilities as private landholders since the Act binds the Crown.

Local Action Groups and Community members (Local)

Groups like the Blinman Parachilna Pest Plant Group (BPPPG), as well as numerous volunteer groups and landholder groups, conduct vital on ground action to support local landholders, while also providing a sub regional and local focus into regional and state programs and policy.

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NRM Boards (Regional)

The NRM Boards should aim to ensure impacts are kept to a minimum throughout the area by;

- Ensuring all stakeholders are aware and engage in strategic control activities,
- Liaising with government departments, other NRM Boards and community groups to undertake control,
- Administering the provisions of the *Natural Resource Management Act 2004*,
- Allocating resources for control,
- Coordinating integrated management activities.

Whilst regulatory activities are generally viewed as a last resort in obtaining stakeholder cooperation in undertaking pest management, there are likely to be instances where these powers are required.

State Opuntia Taskforce (State)

The taskforce is supported by and has representatives from EP, N&Y, SAAL, and SAMDB NRM Boards and Biosecurity SA. The terms of reference outline the purpose of the taskforce;

- i. To coordinate and provide for the exchange of information between the various control initiatives and field work around the State.
- ii. To provide a clearer overall picture of and better evaluate the risk to the State represented by the spread of opuntoid cacti.
- iii. To provide recommendations for the better coordination of opuntoid cactus policy.
- iv. To investigate and promote more strategic and cost effective options for opuntoid cactus control.
- v. To raise awareness and seek support from other States (and at the National level) in order to accelerate the implementation of any bio-control opportunities.
- vi. To assist with the implementation of existing control methods.

Department of Environment and Natural Resources (DENR) (State)

DENR has the lead role in implementing the State Natural Resources Management Plan which includes (Goal 4) 'Integrated management of biological threats to minimise risks to natural systems, communities and industry'.

Biosecurity SA

NRM Biosecurity within Biosecurity SA will continue to support research and provide technical advice on opuntoid cacti issues to the NRM Boards and implement some functions of the Chief Officer under the NRM Act. As the lead agency for weed management in the State, Biosecurity SA are responsible for developing state wide policies and providing legislative recommendations to the Minister.

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8 Strategic plan

8.1 Principles

The principles underpinning this plan are those identified in the National Weeds Strategy:

1. Weed management is an essential and integral part of sustainable management of the natural resources and the environment and requires an integrated, multi disciplinary 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 which involves all levels of government in establishing appropriate legislative, educational and coordination frameworks in partnership with industry, landholders and the 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.

This plan has been established to provide a co-ordinated framework for the management of opuntoid cacti on a state wide level. This strategy has direct links to other State level plans, contributes to targets at the national level and is supported by targets at the regional level. Figure 4 lists these relevant strategies.

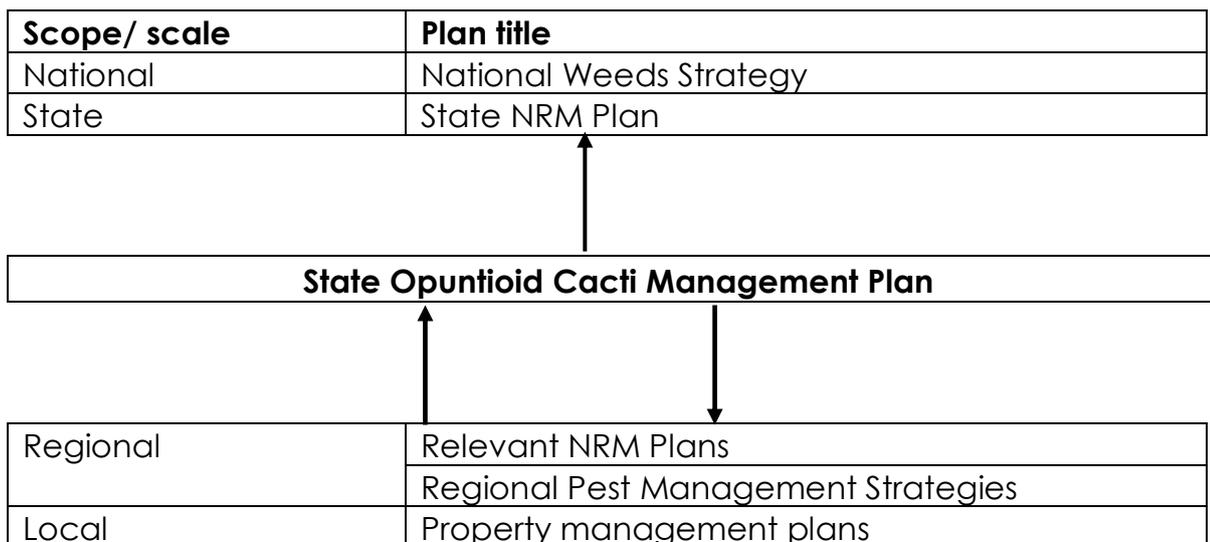


Figure 8.1: Links between this Opuntoid cacti management plan and other relevant weed strategies

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8.2 Outcomes

Outcome 1: Opuntoid cactus species are effectively managed across the State

Outcome 2: Land managers are informed and actively involved in opuntoid cacti management

8.3 Goals

The goals for opuntoid cacti management are:

To maintain a productive landscape

To restore native biodiversity in affected areas

To maintain tourism values and access

To develop a community that is responsive to threats

8.4 Objectives

The participants of the workshop identified four primary issues, these were; Opuntoid cactus management, education and awareness, funding and involvement (see Appendix B for details). Consequently the five objectives of this plan are based on these themes:

Objective 1: No new infestations of opuntoid cacti are established

Objective 2: Current infestations are actively managed to prevent further spread

Objective 3: Research into opuntoid cactus management is supported

Objective 4: Land managers and the community are aware and informed

Objective 5: Land managers and the community are actively involved in opuntoid cactus management.

The current state policy for opuntoid cacti, known generically as prickly pear, can be viewed in Appendix A.

8.5 Implementation

Actions and their levels of action are presented in Table 4. Actions at the regional level are within the jurisdiction of the respective Natural Resource Management Boards, while State level actions will require co-ordination by Biosecurity SA.

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Table 4: Summary of objectives, actions and responsibilities

Objectives	Action	Level of action
1. No new infestations of Opuntoid cacti are established	1.1 Ensure declaration under NRM Act is adequate to prohibit the introduction of new species	State Regional
	1.2 Identify and conduct risk assessment of pest opuntoid cactus species not yet known to occur in South Australia which may threaten industry and biodiversity.	State
	1.3 Conduct risk assessment of opuntoid cactus species of concern to determine threat to SA industry and biodiversity assets.	State Regional
	1.4 Support the framework for the early identification and detection of opuntoid cactus species.	State Regional
	1.5 Undertake surveillance and mapping of key priority areas.	State Regional Local
2. Current infestations are actively managed to prevent further spread	2.1 Collate, update and maintain a database of opuntoid cacti distribution and density for SA, and make it available for NRM Boards and local groups to aid in priority setting	State Regional
	2.2 Undertake inspections to assess the density and distribution of opuntoid cacti	Regional Local
	2.3 Prioritise and actively manage outlier infestations	Regional Local
	2.4 Ensure opuntoid cacti management is included in regional and property planning processes	Regional Local
	2.5 Land managers are motivated to reduce and contain core infestations	Regional Local
	2.6 All management programs are monitored and evaluated	Regional Local
3. Research into Opuntoid cacti	3.1 Conduct predictive modelling of potential distribution of opuntoid cactus species.	State Research organisations

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management is supported	3.2 Support the investigation and implementation of biological control for all opuntoid cactus species, particularly <i>O. robusta</i>	State Research organisations
	3.3 Investigate other control measures (biological, chemical) especially those suited for dense/ large infestations of opuntoid cacti	State Regional
	3.4 Support continued research into biological and ecological studies of opuntoid cactus species	State and research organisation
4. Land managers and the community are aware and informed	4.1 Best practice management information is produced and readily available in a variety of media formats	State Regional Local
	4.2 Identification material for opuntoid cactus species is produced and readily available in a variety of media formats	State Regional Local
	4.3 A variety of media formats including TV, radio, internet, print and face to face (field days and demonstration days) are utilised to raise awareness about opuntoid cacti and publish the factors underpinning success of programs.	State Regional Local
5. Land managers and the community are actively involved in Opuntoid cacti management	5.1 Seek support and engagement for the management of opuntoid cacti from community, industry and all levels of government.	State Regional Local State Taskforce
	5.2 Encourage and support local action and volunteer groups	State Regional Local
	5.3 Maintain a group of representatives from across the state with a focus on opuntoid cactus management.	State Regional
	5.4 Establish and maintain cross jurisdictional networks with relevant intra/ inter state agencies, groups and individuals.	State Regional State Taskforce

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8.6 Monitoring and Evaluation

Monitoring is important to:

- Assess effectiveness of control measures
- Identify new weed infestations
- Maintain data on current infestations

The success of opuntioid cactus control is dependant on monitoring and timely follow up control. Monitoring should be undertaken:

- periodically after control treatments (e.g. 1 month and 12 months)
- After a potential change in conditions, e.g. flood events, land use change
- Annually in areas located near known infestations and along creek lines to prevent new plants establishing
- At least every 5 years in clean areas

Monitoring methods can include:

- Formal ground surveys on foot, bike or vehicle
- As part of normal property inspections
- Via photo points
- Via aerial surveys if terrain permits
- Via desktop analysis of aerial imagery (currently being investigated)

Data collected from monitoring efforts will be at different scales and likely in different formats. Ideally, a GPS should be used to record location information. However, if a GPS is not available (e.g. to landholders), information can be digitised from maps. The ability to access GPS at certain times (e.g. mustering) will ensure timely and accurate recording, thus it is suggested that the NRM Boards could provide access to equipment (e.g. through hiring). Where possible, when collecting monitoring data it is important to collect some basic/standard information like;

- Date of collection
- Location
- The name or agency of the person collecting the data
- Species
- Size (preferably in ha or m²)
- Density of infestation (% of area covered)
- Reason for collecting data e.g. inspection, treatment, follow up, monitoring.

Standard data collection will allow sharing between different stakeholders and regions. For strategic management across the state, sharing of data is important to understand the scope of distribution. A national standard for the collection of data exists and can be found at <http://www.weeds.org.au/mapping.htm>. There are numerous other attributes that can be collected and by combining this data with other datasets the applications of the data are limitless.

It is also important that the data are accessible to all relevant stakeholders. Mechanisms are required for landholders to feed their data into existing

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databases. Currently each NRM Board has their own database for their region, e.g. SAMRIC in the SA MDB and ALIS for the SAAL region. It is recommended that the State Opuntia Taskforce and community groups can access these databases for strategic management including:

- priority setting at various scales,
- monitoring the effectiveness of current management decisions,
- understanding distribution, and
- influencing future management decisions.

As well as monitoring control actions, evaluation is needed to:

- Determine what methods are working and how to adapt them for improved best practice

Evaluation should focus on effectiveness, appropriateness and efficiencies of the outputs of a control program. Evaluation is only possible if outcomes are measurable and can be compared to previous status. It is recommended that each control program defines outcomes, e.g. 80% kill in first application, prior to the control being undertaken.

Monitoring and Reporting Frameworks (MERF)

Monitoring and Reporting/ Evaluation Frameworks exist at many levels, they evaluate/ report project outcomes and activities against defined targets, objectives and indicators at higher levels (regional, state , national). Project activities have been captured using a variety programs (e.g. NRM Tracker). 'Interplan' is a web program currently being utilised by NRM boards and state agencies (DENR) to collect information pertaining to project outcomes and allow reporting against Key Performance Indicators (KPIs). This program is built on the "Collect once, report many" principle, and once tailored to a project can collect key information needed to satisfy the reporting requirements of multiple funding agencies at varying levels i.e. from national to local programs. The national NRM MERI (Monitoring, Evaluation, Reporting and Improvement) Framework is being applied to Caring for Our Country projects, focusing project development and implementation on achieving measurable outcomes.

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10 Appendices

- A. Current *Opuntia* State Policy
- B. SA Govt non declared plant policy, Indian Fig (*Opuntia ficus-indica*)

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10.1 Appendix A: State Declared Plant Policy – Prickly Pear

Declared Plant Policy prickly pear (*Opuntia* species)

Background

Prickly pears (*Opuntia* spp.) have been planted extensively throughout South Australia, and are particularly common in settlements in the arid zone. In some localities prickly pear has spread from the original plantings to become a nuisance over large areas. The major infestations are in the Flinders Ranges, River Murray cliffs and pastoral lands near Peterborough and Port Augusta. Prickly pears are weeds of bushland and rough pastoral land rather than of arable land. This document considers all *Opuntia* species other than the crop species Indian fig (*Opuntia ficus-indica*).

The major weedy species of *Opuntia* are the common pest pear (*O. stricta*), drooping prickly pear (*O. vulgaris*), devil's rope cactus (*O. imbricata*) and wheel cactus (*O. robusta*).

Prickly pears are commonly cultivated as garden plants and where established as weeds have originated from abandoned local gardens. The fruit of prickly pear is eaten by birds, which effectively disperse the seed of some species over wider areas. Infestations can also start when pads are dumped with garden waste.

Prickly pear is of no fodder value

Co-ordinated Control Program

Aim:

To prevent prickly pear from competing with more desirable plants and restricting access in the pastoral areas of the State.

Objectives:

- a) To destroy all isolated infestations away from cultivated gardens.
- b) To contain all large infestations.
- c) To end the cultivation of prickly pear in gardens.
- d) To prevent introductions of additional prickly pear species to pastoral and inaccessible areas of the State.

Implementation:

- a) NRM authorities to ensure all prickly pear outside of cultivated gardens on private or public land are controlled or destroyed.
- b) NRM authorities to destroy all infestations on road reserves.
- c) NRM authorities to develop and implement a plan to control or contain large infestations.
- d) NRM authorities to develop a plan for the removal of cultivated aggressive

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forms of prickly pear.

- e) To prevent further planting of prickly pear in semiarid areas, NRM authorities are to ensure plants are not sold.

Priorities for NRM authorities:

- a) Determine distribution and abundance of infestations.
- b) Develop a local co-ordinated program.
- c) Implement this co-ordinated program.

Declaration

To implement this policy, all *Opuntia* species excluding spineless *O. ficus-indica* are declared for the whole State. Sale of these plants, their fruit and fruit or seed are prohibited to prevent cultivation. Owners of land are required to control plants growing on land they occupy, and NRM authorities are required to control plants on road reserves, and cultivation will be phased out to prevent spread. The costs of controlling plants on road reserves is to be met by adjoining landholders.

Prickly pear is declared under the *Natural Resources Management Act, 2004*, with the following sections applying for the whole State.

- 175(1)(2) Prohibiting movement on public roads and entry into SA.
- 177(1)(2) Prohibiting sale of the plants or their seeds, or contaminated material.
- 182(1)(3) Requiring landowners to destroy the plant on their properties.
- 185(1) Allowing recovery of costs of control on road reserves.

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10.2 Appendix B: State non declared plant policy, Indian Fig (*Opuntia ficus-indica*)

Policy Indian fig (*Opuntia ficus-indica*)

Background

Indian fig (*Opuntia ficus-indica*) is commonly cultivated for domestic use in the Riverland and the Adelaide Metropolitan area. Following requests from horticulturalists wishing to grow Indian fig commercially and the apparent anomaly with Indian fig plants permitted in gardens in some control areas the former Animal and Plant Control Commission reconsidered its policy on the plant.

Indian fig differs from other *Opuntia* species as it has been selectively developed over many centuries for fruit size and flavour and for thornless growth. It retains the numerous minute barbed bristles or glochids around the areoles of young pads and fruits but is readily browsed by livestock. Its dispersal by birds feeding on the fruit has never been recorded in Australia, despite the large number of cultivated plants. Indian fig can establish from pads which fall to the ground or when plants are dumped.

Discussion

Indian fig has been specifically excluded from noxious weed lists in NSW since 1978 and has never been declared in Victoria, where many small plantations are established, the largest being one of 10 ha at Glenrowan. Commercial Indian fig production would allow a new horticultural industry to develop, as there is a local demand for fruit which has been supplied from time to time by interstate imports.

The cultivated Indian fig is easily distinguished from other *Opuntia* species which have long spines, or pads of manifestly different size and shape.

The previous control program prohibiting sale of fruit and commercial plantations but tacitly allowing the maintenance of non-commercial backyard plantings did little to reduce the likelihood of spread of Indian fig. Less spread may be expected to occur from a few managed plantations than from the many backyard plants.

To treat Indian fig under the same policy as other *Opuntia* species, enforcing a prohibition on its cultivation and the sale of fruit would cause major hardship to some community groups and prevent the development of an Indian fig industry. Enforcement would also make a heavy demand on the resources of urban Councils as well as creating friction between them and the backyard growers of this plant.

Therefore, a co-ordinated control program for Indian fig is neither necessary nor desirable. The proclamation has now been varied to specifically exclude all spineless forms of Indian fig from the Act.

This policy applies only to spineless forms of Indian fig, and vendors must refer to this fruit as Indian fig. Prickly pear fruit is not to be sold and *Opuntia ficus-indica* fruit labelled as prickly pear is not exempt from the Act.

Declaration

Unlike all other species of *Opuntia*, Indian fig is not declared under the *Natural Resources Management Act, 2004*.