Government of South Australia
South Australian Arid Lands Natural Resources Management Board



Reviewed June 2015

South Australian Arid Lands Natural Resources Management Board

KINGOONYA NRM DISTRICT WEED STRATEGY

KINGOONYA NRM DISTRICT WEED STRATEGY

JODIE RESEIGH AND BEN SHEPHERD

RURAL SOLUTIONS SA

JUNE 2010

REVIEWED IN JUNE 2015 BY PAUL HODGES, DEWNR

Acknowledgements

This Strategy is funded by Caring for Our Country, through the South Australian Arid Lands NRM Board

The authors wish to convey special thanks to the following people:

Greg Patrick (SAAL NRM Board) for his time in helping develop this Strategy and review comments

John Pitt (Rural Solutions SA) for his technical advice and review comments

Stuart Wright (Rural Solutions SA) for developing the maps

The individual artists for use of their photographs

Disclaimer

The South Australian Arid Lands Natural Resources Management Board, and its employees do not warrant or make any representation regarding the use, or results of use of the information contained herein as to its correctness, accuracy, reliability, currency or otherwise. The South Australian Arid Lands Natural Resources Management Board and its employees expressly disclaim all liability or responsibility to any person using the information or advice.

Front cover photos. Mesquite (*Prosopis spp*.). Photo B. Shepherd
Buffel Grass (*Cenchrus ciliaris*) Photo B. Shepherd
Athel Pine (*Tamarix aphylla*) Photo B. Shepherd

Government of South Australia
South Australian Arid Lands Natural Resources Management Board

Table of Contents

Purpose of Strategy

It is intended that this strategy be used by the Kingoonya NRM District Group to guide prioritisation of weed management activities within their district over the next five years.

The strategy outlines management actions that the Group can implement within their District that will reduce the current and potential impacts of ten priority weeds.

The management actions outlined for each of the ten priority weeds are in line with South Australian state policies for declared weeds and the SA Arid Lands NRM Board regional weed policies.

The strategy also provides information regarding the distribution, possible threats and impacts and policy on each of the ten priority weeds and outlines current best practise control methods and surveying/monitoring activities.

Furthermore, it is recommended that the group review this strategy in five years to assess progress and update management actions where required.

Some of the plant species discussed in this strategy are valued amenity trees (e.g. Pepper Trees and Athel Pine) within station gardens, while others are generally undesirable plants (e.g. cactus and African Rue). Most of the weeds are currently at low densities, while others have infested large areas. All the plants dealt with in this strategy have a demonstrated ability to rapidly expand their distribution given favourable seasonal conditions. Managing current infestations and removing potential sources for new infestations will save the considerable amounts of time and money required to control large infestations of persistent weeds.

The District groups can be influential in the implementation of on-ground natural resource management programs within their district. By implementing this strategy the Kingoonya NRM District group can develop proactive weed management programs within their district for the long term protection of its environmental and productive assets.

The Kingoonya NRM District

The Kingoonya NRM District makes up a portion of the western side of the South Australian Arid lands NRM Region. It covers an area of approximately 65,815 square kilometres and is bound by the dog fence to the north and west and salt lakes to the south and east. It includes the townships of Roxby Downs, Woomera, Pimba, Andamooka, Glendambo, Kingoonya and Tarcoola. The population of the district is estimated at 4,000 people predominantly associated with mining. Pastoralists make up a small portion of the population and manage the majority of the land. Sheep, and to a lesser extent cattle, grazing is the dominant land use and gold, uranium and iron are mined at Olympic Dam and Prominent Hill mining leases. Other land uses in the region include defence industry operations at Woomera, tourism and private conservation reserves. There are no National Parks in the district.

The climate is semi-arid and arid with highly variable rainfall ranging from 150 mm in the north-east to 200 mm in the south-west. There is no apparent seasonal rainfall however there are slightly more wetter days in the cooler months and the highest daily rainfalls tend to occur in the summer months.

The region spans portions of the Gawler and Stony Plains bioregions. The major land forms within this region include sand plains, woodlands, sand dunes, gibber flats, drainage systems, salt lakes and uplands. Vegetation is predominantly mulga low woodland in the west and chenopod low shrub land in the east, although integration of these vegetation types does occur.

Naturally occurring permanent water is limited, with water in the region is sourced from local ground water, the Great Artesian Basin, local surface water stored in dams and waterholes and water sources from outside the district. Water holes within the large arid ephemeral drainage lines can store water for 1-2 years however these are unreliable.

As with much of northern South Australia, the Kingoonya NRM district is relatively free of large infestations of problematic weeds. Several species of short lived weeds occur throughout the district and are not viewed a problem, nor is control a practical option. Other weeds of medium to low importance, either widespread or in certain areas of the district include Onion Weed, Evening Primrose, Salvation Jane, Cut-leaf Mignonette, Horehound and several ‘township’ species e.g. Soursob, Couch etc; in the towns of Roxby Down and Woomera.

Some weeds (primarily those dealt with in this strategy) have a limited distribution but constitute a potential threat to the region. These weeds include various Cactus

species which have escaped from a few gardens in the region; Buffel Grass and African Rue, which were thought to be spread into the region along the Stuart Highway, Mesquite and Parkinsonia which are of high concern and have naturalised around the Woomera Township area; and African Boxthorn which has likely been in the region for years. Athel Pine and Pepper Trees are common garden and township plantings which have demonstrated invasiveness along rivers in other parts of Northern South Australia and have the potential to do so in the Kingoonya district.

The Kingoonya NRM district is a unique area with an opportunity to strategically and effectively manage weed threats for the long term protection of its productive and environmental assets.

The Kingoonya NRM District Group

The District Groups were established to provide a vital link in communicating community issues to the SA Arid Lands NRM Board and provide a local perspective on implementing on-ground projects.

The District Group members of the Kingoonya NRM District Group as at June 2015 are:

Graeme Noll

Katie Hulmes

Michael Chuk

Julia Harris

Brenton McRae

Chris Larkin

Ashley Williams

Murray Tyler (Board Rep)

Target Weeds

The weeds chosen as priorities for the Kingoonya NRM District and dealt with in this strategy are declared weeds under the Natural Resources Management Act 2004 and/or demonstrated to be regional threats where the feasibility of control is high i.e. they are strategic control opportunities. An initial list of priority weeds were presented to the District Group from which the top ten priority weeds were selected.

Weed risk assessments have been undertaken by the SA Arid Lands NRM Board on each of the ten priority weeds. This process determines a weeds risk (low, medium or high) in a particular land system (in this case the Gawler and Stony Plains Bioregions) by assessing the weeds invasiveness, impact and potential distribution. Through the assessment of each weeds risk, the management strategy for each weed was identified (Table 1).

Table 1. Ten priority weeds included in the Kingoonya NRM District Strategy, the management strategy and description of the management strategy for each weed. NB Cactus species have different management strategies depending on the weeds risk.

Priority Weed	Management strategy	Description of management strategy
African Boxthorn	Manage sites	African Boxthorn is common in the District and the Group should aim to reduce the overall economic and/or social impacts of this weed through targeted management. See page 11 for more details
African Rue	Protect sites	African Rue has a very limited distribution within the District and the Group should aim to prevent spread of this weed. See page 15 for more details
Athel Pine	Protect sites	Athel Pine has a limited distribution within the District, primarily all amenity plants, and the Group should aim to prevent spread of this weed (particularly along water courses). See page 188 for more details
Buffel Grass	Protect sites	Buffel Grass has a very limited distribution within the District and the Group should aim to prevent spread of this weed. See page 22 for more details
Cactus species (Wheel Cactus, Engelmann's Prickly Pear & Prickly Pear)	Contain spread	These species are common in parts of the District and the Group should aim to prevent the ongoing spread of these species through targeted control. See page 25 for more details
Cactus species (Devils Rope, Hudson Pear, Jumping Cholla and Coral Cactus)	Destroy	These species have a very limited distribution within or close to the District and the Group should aim to significantly reduce the extent of these weeds through control of all infestations found. See page 25 for more details.
Innocent Weed	Protect sites	Innocent Weed has a very limited distribution within the District and the Group should aim to prevent spread of this weed. See page 33 for more details
Khaki Weed	Destroy	Khaki Weed has a very limited distribution within or close to the district and the group should aim to destroy all known occurrences. See page 366 for more details
Mesquite	Destroy	Mesquite has a very limited distribution within or close to the district and the group should aim to destroy all known occurrences. See page 40 for more details
Parkinsonia	Eradicate	Parkinsonia has very limited distribution within or close to District and the Group should aim to eradicate these weeds from the region. See page 444 for more details
Pepper Tree	Manage sites	Pepper Trees are common within the District and the Group should aim to reduce the overall economic and/or social impacts of this weed through targeted management. See page 47 for more details

Table 2. Management Strategy aims and actions definitions

Management strategy	Aims & actions of management strategies
Alert	Species that are not known to be present in the management area and which represent a significant threat if permitted to enter and establish. **Aims to prevent the species arriving and establishing in the management area.** • Prevention of entry to management area • Ongoing surveillance for incursions of the species • Training & awareness activities for the community to enable early detection
Eradicate	**Aims to remove the weed species from the management area.** • Detailed surveillance & mapping to locate all infestations • Destruction of all infestations including seed banks • Prevention of entry to management area and movement within • Must not grow and all cultivated plants to be removed • Monitor progress towards eradication
Destroy	**Aims to significantly reduce the extent of the weed species in the management area.** • Detailed surveillance & mapping to locate all infestations • Destruction of all infestations, aiming for local eradication at feasible sites. • Prevention of entry to management area and movement and sale within • Must not grow • Monitor progress towards reduction
Contain spread	**Aims to prevent the ongoing spread of the weed species in the management area.** • Surveillance & mapping to locate all infested properties • Control all infestations, aiming for a significant reduction in weed density • Prevention of entry to management area and movement and sale within • Must not allow to spread from cultivated plants (if grown) • Monitor change in current distribution
Protect sites	**Aims to prevent spread of the weed species to key sites/assets of high economic, environmental and/or social value.** • Weed may be of limited current distribution but only threatens limited industries/habitats (lower weed risk). Or the weed may be more widespread but is yet to invade/impact upon many key industries/habitats (higher weed risk) • Surveillance & mapping to locate all infested properties • Identification of key sites/assets in the management area • Control of infestations in close proximity to key sites/assets, aiming for a significant reduction in weed density. • Limits on movement within the management area • Must not allow to spread from cultivated plants (if grown) in close proximity to key sites/assets • Monitor change in current distribution within and in close proximity to key sites/assets

Manage weed	**Aims to reduce the overall economic, environmental and/or social impacts of the weed species through targeted management** • Research and develop integrated weed management (IWM) packages for the species, including herbicides and biological control, where feasible • Promote IWM packages to landholders • Monitor decrease in weed impacts with improved management • Identify key sites/assets in the management area and ensure adequate resourcing to manage the weed species
Manage sites	**Aims to maintain the overall economic, environmental and/or social value of key sites/assets through improved general weed management.** • Promote general IWM principles to landholders, including the range of control techniques, maintaining competitive vegetation/crops/pastures, hygiene & property management plans • Identify key sites/assets in the management area & ensure adequate resourcing to manage these to maintain their values • Broaden focus beyond weeds to all threatening processes
Monitor	**Aims to detect any significant changes in the species' weed risk** • Monitor the spread of the species and review any perceived changes in weediness
Limited action	**The weed species would only be targeted for coordinated control in the management area if its local presence makes it likely to spread to land uses where it ranks as a higher priority** • Undertake control measures if required for the benefit of other land uses at risk • Otherwise limited advice to land managers, if required

Review period

This strategy was developed in 2010 and has been implemented over the past 5 years. This strategy was reviewed in June 2015 and will be reviewed every 5 years from now on.

Suggested time frame:

Year	Activity
2015	Strategy reviewed by the Group and feedback incorporated into the Strategy Strategy endorsed by the group
2016	Implementation
2017	Implementation
2018	Implementation
2019	Implementation
2020	Review progress and update the strategy as required.

Target Weeds and their strategy

African Boxthorn

Common name(s): African Boxthorn

Scientific name: *Lycium ferocissimum*

Plant description: Branched shrub to 5 m high and 3 m wide. Spines occur on the main stems and branchlets, and branchlets terminate with a spine

Slightly fleshy leaves (10-40 mm long), in clusters at the nodes.

Flowers are pale lilac to white with purple markings at the base.

Fruit is dull orange-red berry (1 cm diameter).

Photo 1: African Boxthorn leaves and spines (Photo J Pitt)

Photo 2: African Boxthorn with immature and mature fruit (Photo J Pitt)

Flowering: Predominately in summer (but may occur all year round)

Origin: South Africa

When introduced: 1845

Why introduced: Introduced as a hedge plant

Other information: African Boxthorn fruit is the breeding place for numerous insects including common house fly, fruit fly and dried fruit beetles.

Threats and Impacts

Invasiveness African Boxthorn can only be dispersed through seed, which is eaten by birds and foxes and viable when excreted. Seed can be easily dispersed over large areas, particularly under trees, poles and fences where birds have perched.

Regrowth may occur from broken roots and cut stumps following physical control.

Impacts

African Boxthorn may form dense stands which compete with native species and pastures. The sharp spines prevent grazing and make stock movement difficult, particularly near watercourses which may prevent access.

African Boxthorn can impact on native fauna by reducing habitat quality.

Thickets of African Boxthorn can harbour feral pests such as foxes and rabbits.

Persistence

African Boxthorn has the ability to reshoot and reinvade areas where control has been undertaken therefore long-term follow-up is required.

Reinfestation of Boxthorn may occur from untreated plants in surrounding areas.

Distribution

Current Australian distribution:

All states

Current South Australian distribution:

In South Australia, common in large areas of the arid lands and on islands off Eyre Peninsula

Current District distribution:

Although few records of African Boxthorn are shown in Map 1, it is likely that this weed is common at low densities at least in the southern parts of the district. The locations marked on Map 1, do not represent all known locations of African Boxthorn, rather African Boxthorn data collected since 1972.

Potential distribution:

African Boxthorn has the potential to infest watercourses and flood plains, especially where Boxthorns are located upstream. Boxthorns may increase in density where unmanaged.

Policy

National Strategy:

African Boxthorn is classified as a Weed of National Significance (WONS).

The extent and potential of African Boxthorn in Australia will be well understood, stakeholders well equipped with information tools and knowledge, and strategic management will contain and reduce the weed's impacts.

State Policy:

To protect native vegetation and maintain access to pasture throughout SA.

Under the *Natural Resources Management Act*, 2004:

- Restricting movement of African Boxthorn on public roads.
- Prohibiting sale of African Boxthorn or produce or goods carrying African Boxthorn.
- Requiring an owner of land to destroy African Boxthorn and inhibit its propagation as far as is reasonably achievable.
- Allowing NRM Boards to recover costs of control of African Boxthorn on road reserves from adjoining landowners.

SA Arid Lands NRM Policy:

The SAAL NRM regional management strategy for African Boxthorn is to MANAGE sites.

Aim: To reduce the overall economic, environmental and/or social impacts of African Boxthorn through targeted management.

Kingoonya NRM District Risk management strategy:	Kingoonya NRM District management strategy is to MANAGE sites infested with African Boxthorn, Aim: To maintain economic, environmental and/or social values of key sites/assets through improved management of African Boxthorn,

Kingoonya NRM District Strategy for management of African Boxthorn

Recommended Actions
Support land manager education in identification, monitoring and control of African Boxthorn.
Kingoonya NRM District Group to encourage landholders to provide data on distribution of African Boxthorn in Kingoonya NRM District to NRSAAL, so that it can be surveyed and mapped.
Kingoonya NRM District group to assist, where possible, in identifying and coordinating African Boxthorn control programs using integrated weed management (combination of recommended best practices).
Land managers encouraged to monitor success, following control of African Boxthorn, and carry out follow up control as necessary.
Kingoonya NRM District group to encourage landholders to use best practice hygiene (to prevent movement and spread of African Boxthorn).

Best Practice Control

Control method and description	**Best time to control**	**Active ingredients and example trade names**	**Herbicide rates and carrier**
Foliar Spray			
Useful for all sized plants. The entire plant is sprayed when actively growing, i.e. when the plant has green healthy leaves. Plants should not be sprayed when they are stressed or when plants do not have foliage. Boxthorns are deciduous plants and will shed their leaves during winter and/or when stressed.	Summer and Spring when actively growing	Metsulfuron-methyl (600g/kg) e.g. Brush-off® + glyphosate (360g/L) e.g. Roundup®	Consistent with label rates in water with a penetrant e.g. Pulse®
Basal Bark			
Useful for all sized plants Spray all sides of each stem with the recommended herbicide mix, to a height of between 250 – 750 mm above soil level.	Summer and Spring when actively growing	Triclopyr 600 g/L e.g. Garlon® Triclopyr 240 g/L + Picloram 120 g/L e.g. Access®	33 mls/L mixed in diesel 17 mls/L mixed in diesel
Cut Stump			
Useful for all sized plants Cut the entire plant down at the base using a chainsaw and immediately (within 10 seconds) spray or paint the recommended herbicide mix onto the cut stump.	Summer and Spring when actively growing	Triclopyr 600 g/L e.g. Garlon® Triclopyr 240 g/L + Picloram 120 g/L e.g. Access®	33 mls/L mixed in diesel 17 mls/L mixed in diesel
Physical			
Small plants can be hand-pulled or dug up. Large plants can be removed using heavy machinery. Best done when there is ground moisture as the plants will be more readily removed. Uprooted plants should be piled & destroyed by burning as they can provide shelter for vermin and the spines can still cause injury. After removal, the area should be monitored for regrowth from root fragments left in the soil, and for germinating seedlings.			

Surveys/ Monitoring

General method:	Keep an eye out for African Boxthorn during routine pastoral management activities and record locations using a GPS.
Best time of year for surveys:	Spring and summer as well as in the weeks and months after rainfall events when it is bright green.

African Rue

Common name(s): African Rue

Scientific name: *Peganum harmala*

Plant description: Perennial herb or shrubby plant 30-80 cm high.

Leaves 1-5 cm long, bright green, divided several times into three or more linear segments.

Flowers, with 5 white broad petals (12- 17 mm long).

Fruit is slightly flattened capsule (8-12 mm across, 7-12 mm long) which opens at the top, containing black angular seeds.

Photo 3: African Rue plant (Photo B. Shepherd)

Photo 4: African Rue flowers (Photo Courtesy DWLBC)

Flowering: Late spring – early summer

Origin: Mediterranean region and Middle East

When introduced: Unknown

Why introduced: Unknown, was once used in Medicine

Other information: African Rue is considered an aphrodisiac in India. Its seeds and leaves have been used medicinally for treatment of various aliments including asthma, jaundice, colic and as a diuretic.

Threats and Impacts

Invasiveness Dispersal of the plant is predominately through seed, with the majority of seed being dropped close to the parent plant. Seeds can easily be dispersed through water flow, but also in mud moved by animals or vehicles. Stock and other animals may also eat the fruit and aid in the dispersal of African Rue.

African Rue prefers disturbed sites with little or no competition, and requires moisture for seed germination.

African Rue is drought and salt tolerant, and therefore has the potential to have large impacts in semi-arid and arid areas.

Impacts

African Rue can be toxic containing more than 25 alkaloids, however the plant is highly unpalatable to livestock (few poisonings have been reported).

The likely impact on native vegetation is unknown, but due to its tolerance to drought and salt the potential impacts could be large.

Persistence

African Rue is difficult to destroy once established as regeneration may occur from severed root pieces. African Rue is known to persist despite treatment with herbicide or manual removal.

Distribution

Current Australian distribution:

Confined to News South Wales and South Australia.

Current South Australian distribution:

Known to occur in patches at Tintinara, Taylorville and Snowtown as well as numerous other sites. In the SAAL region African Rue primarily occurs along roadsides and flood out areas. A core infestation exists in the eastern pastoral district and other occurrences exist in the northern Flinders Ranges and in the area between Lake Torrens and Port Augusta including along the Stuart Highway.

Current District distribution:

There is a small population of African Rue on the road between Mt Vivian and Mt Eba homesteads in the Kingoonya District.

Potential distribution:

African Rue has the potential to become widespread throughout the arid lands region in disturbed areas such as roadsides and areas receiving run-on water such as flood outs and depressions. The zone of potential distribution has been described as between the 350 mm and 175 mm isohyets.

Policy

National Strategy:

African Rue is not classified as a Weed of National Significance, therefore there is no National Strategy for this species.

State Policy:

African Rue is a declared species under the Natural Resources Management Act, 2004.

To prevent establishment in uninfested pastoral lands

Under the *Natural Resources Management Act*, 2004:

- Prohibiting movement of African Rue on roads
- Prohibiting the sale of African Rue or contaminated produce
- Requiring landholders to control African Rue on their properties
- Allowing recovery of roadside control costs of African Rue from adjoining landholders

SA Arid Lands NRM Policy:

The SAAL NRM regional management strategy for African Rue is to PROTECT sites

Aim: To prevent spread of African Rue to key sites/assets of high economic, environmental and/or social value.

Kingoonya NRM District management strategy:

Kingoonya NRM District management strategy is to PROTECT sites from the spread of African Rue

Aim: To prevent spread of African Rue to key sites/assets of high economic, environmental and/or social value.

Kingoonya NRM District Strategy for management of African Rue

Recommended Actions
Support land manager education in identification, monitoring and control of African Rue.
Kingoonya NRM District Group to encourage landholders to provide data on distribution of African Rue in Kingoonya NRM District to NRSAAL, so that it can be surveyed and mapped.
Kingoonya NRM District group to assist in identifying and coordinating African Rue control programs using integrated weed management (combination of recommended best practices), especially in areas where key sites are threatened.
Land managers encouraged to monitor success, following control of African Rue, and carry out follow up control as necessary.

Best Practice Control

African Rue can be a difficult plant to kill due to its deep roots, on-going monitoring and repeated applications of herbicide will be required annually and after rainfall events.

Increasing competition from native plants, by reducing grassing pressure from livestock, rabbits and kangaroos in areas where African Rue is present will provide long term suppression and reduce its proliferation.

Control method and description	Best time to control	Active ingredients and example trade names	Herbicide rates and carrier
Foliar Spray			
Useful on all sized plants. African Rue has very deep roots and glyphosate may not effectively translocate to kill established plants. Repeated application over successive seasons is required. Spray the entire plant until run off. Better results will occur on plants that have dust free foliage. Spot spraying with a knap sack or quad/ute mounted spray unit can be used for scattered occurrences. Boom spray can be used for dense infestations where no native vegetation exists between African Rue plants e.g. along roads. Increasing competition from native plants, by reducing grassing pressure from stock, rabbits and kangaroos in areas where African Rue is present will provide long term suppression and reduce its proliferation.	After rainfall events and retreat annually. Best sprayed before the plant flowers.	Glyphosate (360g/L) e.g. Roundup®	Contact the SA Arid Lands NRM Board for current recommended rates in water. A penetrant e.g. Pulse® will also be required.
Cut stump			
Cut off close to the ground and apply herbicide to stump surface immediately.	When actively growing.	Glyphosate (450g/L) e.g. Roundup®	Undiluted
Physical			
Due to its deep roots, African Rue cannot be successfully controlled through hand-pulling or grubbing (it will regrow from the broken root). Organic properties - To provide long term suppression and reduce African Rue proliferation, increasing competition from native plants, by reducing grazing pressure from livestock, rabbits and kangaroos, in areas where African rue is present, is the best option.			

Surveys/ Monitoring

General method:	Undertake targeted surveys and/or opportunistic monitoring of African Rue during pastoral management activities. Especially along and adjacent to roadsides and other disturbed areas. Targeted surveys and control activities should occur annually and/or after rainfall.
Best time of year for surveys:	Anytime of year and especially 2-3 weeks after rainfall.

Athel Pine

Common name(s): Athel Pine

Scientific name: *Tamarix aphylla*

Plant description: Tree to 15 m high, with branchlets which appear jointed but are small leaves (1-2 mm long) surrounding the stem.
Flowers are pink-white, with bell shaped fruit containing numerous seeds.

Photo 5: Mature Athel Pine (Photo B Shepherd)

Photo 6: Athel Pine in riparian zones (Photo B Shepherd)

Photo 7: Pink-white flowers of Athel Pine (Photo B Shepherd)

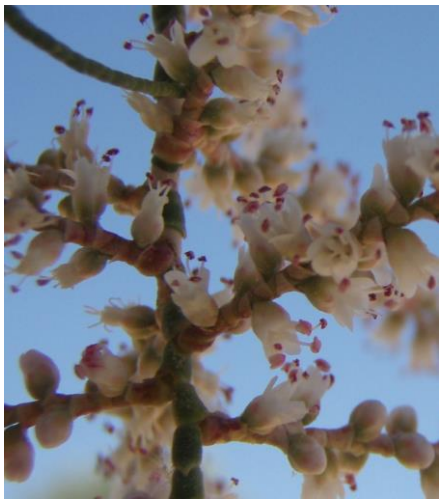

Photo 8: Athel Pine flowers (Photo B Shepherd)

Flowering: Summer

Origin: Mediterranean region, northern Africa and India.

When introduced: 1930-40s

Why introduced: Introduced to arid and semi-arid areas for shade, shelter and erosion control.

Other information: Tamarisk or Salt Cedar (*Tamarix ramosissima*), is a plant similar to Athel Pine which has also shown weedy tendencies in SA, NSW and WA.

Threats and Impacts

Invasiveness

Seeds of Athel Pine require a moist environment to germinate, but the main period of germination is in Autumn.

Seed is easily moved by flood waters and wind, but also by animals, including birds.

Athel Pine also has the ability to reproduce from pieces of stem and root and therefore has the capability spread easily.

Impacts

Athel Pines may form dense stands which compete with native species, both other trees and understorey plants.

Athel Pines may also alter the flow of watercourses, lower water tables, decrease pasture production and make mustering more difficult.

The leaves of Athel Pine excrete salt which leads to high salinity levels in leaf litter.

Persistence

Athel Pine is tolerant to drought and fire resistant, and has the ability to sucker.

Athel Pine commonly reshoots following chemical and mechanical control, therefore follow up control is imperative.

Distribution

Current Australian distribution:

Semi-arid and arid areas of SA, NT, Qld, WA and NSW. Plantings occur across Australia.

Current South Australian distribution:

In the South Australian arid lands planted Athel Pines are common and there are 18 known locations where Athel Pine has gone wild (naturalised).

The largest population of wild Athel Pine occurs in the eastern area of the South Australian arid lands where approximately 50 km of river and lake environment are infested.

Current District distribution:

Athel Pine is a common garden plant in station gardens throughout the Kingoonya NRM district.

Potential distribution:

Athel Pine has the potential to infest all rivers, creeks and waterways in arid areas. Where Athel Pines are located close to drainage lines the lower reaches of the water course are at risk of invasion.

Policy

National Strategy:

Athel Pine is classified as a Weed of National Significance (WONS).

- Non-riparian - Locate, map and remove all high risk Tamarix spp. plantings adjacent to ephemeral lakes and streams in arid and semi-arid areas.
- Riparian - Eradicate all infestations in riparian areas.

State Policy:

To protect native vegetation from invasion by preventing further plantings of this species and by removing existing Athel Pine from high risk areas.

Under the *Natural Resources Management Act*, 2004:

- Prohibiting sale of Athel Pine or contaminated material; and
- Landowners are required to control Athel Pine on their properties where it is within 100m of a watercourse.

SA Arid Lands NRM Policy:

The SAAL NRM regional management strategy for Athel Pine is to PROTECT sites.

Aim: To prevent spread of Athel Pine to key sites/assets of high economic, environmental and/or social value.

Kingoonya NRM District management strategy:	Kingoonya NRM District management strategy is to PROTECT sites from the spread of Athel Pine Aim: To prevent spread of Athel Pine to key sites/assets of high economic, environmental and/or social value.

Kingoonya NRM District Strategy for management of Athel Pine

Recommended Actions
Support land manager education in identification, monitoring and control of Athel Pine.
Kingoonya NRM District Group to encourage landholders to provide data on distribution of Athel Pine in Kingoonya NRM District to NRSAAL, so that it can be surveyed and mapped.
Kingoonya NRM District group to provide input into identification of high priority areas such as significant rivers, creeks and waterholes and coordinate control programs to protect identified priority sites.
Land managers are required to undertake control of Athel Pine plants within 100m of rivers, creeks and waterholes.
Land managers encouraged to monitor success, following control of Athel Pine, and carry out follow up control as necessary.
Introductions and movement of Athel Pine are to be restricted within SAAL NRM Region.

Best Practice Control

Control method and description	**Best time to control**	**Active ingredients and example trade names**	**Herbicide rates and carrier**
Cut stump			
Useful for medium to larger trees. The main stem(s) are cut off and the stump immediately (within 10 seconds) painted or sprayed with the recommended herbicide mixture. The stump should be cut as close to the ground as possible. Remove all cut material from moist environments to prevent root growth from tree sections.	Any time of year	Picloram (43 g/kg) e.g. *Vigilant® Herbicide Gel®* Triclopyr (600 g/L) e.g. *Garlon®* Triclopyr (240 g/L) + Picloram (120 g/L) e.g. *Access®*	Ready to use 35 ml/L mixed in diesel 17 ml/L mixed in diesel
Basal bark			
Useful for smaller trees that have not developed rough bark. Remove all debris from around the base of the tree prior to applying the herbicide. Spray all sides of each stem with the recommended herbicide mix, to a height of between 250 – 750 mm above soil level.	Any time of year	Triclopyr (600 g/L) e.g. *Garlon®* Triclopyr (240 g/L) + Picloram (120 g/L) e.g. *Access®*	25 mls/L mixed in diesel 17 mls/L mixed in diesel
Foliar spray			
Useful when plants are smaller than 2 m. Spray the entire plant with the recommended herbicide mix.	Any time of year	Triclopyr (600 g/L) e.g. *Garlon®*	17 to 35 mls/L mixed in diesel or 10 mls/L mixed in water
Physical			
Useful for very large trees, dense infestations and broad scale germination or regrowth. The entire plant is removed from the ground using a suitable bulldozer or loader. Roots must be cut about 30-50 cm below the soil surface to reduce the incidence of regrowth. This is best done with a blade plough. Branch and root fragments of Athel Pine can take root, therefore woody material must be moved out of creek lines and moist areas. Ongoing inspections and hand-pulling of seedlings will additionally be required where recruitment is occurring, until the seedbank is exhausted.			

Surveys/ Monitoring

General method:	Regular searches along rivers for new occurrences of wild Athel Pine, especially in areas downstream from planted Athel Pine, is important to detect and control Athel Pine before it becomes a problem.
Best time of year for surveys:	Athel Pine is a perennial plant and will be detected anytime of the year. Look for grey, green pine looking leaves growing within river beds in swamps and around water holes.

Buffel Grass

Common name(s): Buffel Grass

Scientific name: *Cenchrus ciliaris*

Plant description: Buffel Grass is a perennial grass to approximately 1 m high, with very strong root stock.

Leaves bluish- green, 3-25 cm long, 1-6 mm wide. Leaf blade base with a rig of short hairs (0.2-2 mm).

Flower heads form a dense hairy cylindrical spike 2-15 cm long, pale or purplish.

Photo 9: Buffel Grass seed head (Photo B Shepherd)

11: Buffel Grass infestation (Photo B herd)

Photo 10: Buffel Grass plant (Photo B Shepherd)

Flowering: Summer

Origin: Native to Africa and south western Asia

When introduced: 1840s

Why introduced: Pasture species in areas with long dry season and for erosion control.

Other information: Can withstand heavy grazing and is the most drought tolerant introduced grass species in Australia.

Threats and Impacts

Invasiveness Buffel Grass is easily distributed by wind, water, stock and machinery. High levels of disturbance, such as flood, fire and heavy grazing, can assist the establishment. Buffel Grass can also root from lower nodes.

The species requires summer rain for growth, and is not frost tolerant.

Impacts

Buffel Grass competes with and displaces native species. It forms monospecific stands, out-competing native grasses.

Plants are fire resistant but can carry fire in areas where fire is not normally part of the ecosystem. Buffel Grass aids fire by increasing the intensity and frequency of natural fire regimes to the point of removing competing shrubs and trees.

Persistence

Buffel Grass is the most drought tolerant introduced grass species in Australia. Buffel Grass is highly persistent on lightly textured soils and is quick to respond to small amounts of rainfall.

Distribution

Current Australian distribution:

Buffel Grass is common throughout central Australia. It was (and continues to be) widely cultivated by pastoralists as a preferred pasture species for cattle. In some outback towns, namely Alice Springs it was cultivated for dust control and has since successfully naturalised and overrun large tracts of land.

Current South Australian distribution:

Large areas in the far north west of northern South Australia are infested with Buffel Grass and it is common along the Stuart Highway (from the Northern Territory border down to about Port Pirie) and the Tarcoola Road. Buffel Grass also occurs along selected rivers of the region with infestations ranging from scattered single occurrences to dense patches. It also occurs in other areas including around townships and as isolated patches along secondary roads.

Current District distribution:

Buffel Grass is common along the Stuart Highway and the road to Tarcoola and isolated occurrences are present around Roxby Downs. Very small populations, with some individual occurrences are present on the secondary roads e.g. the road to Mt Vivian and Mt Eba from Glendambo and the road that runs south from Kingoonya and into the Gawler Ranges.

Potential distribution:

Buffel Grass establishes readily and has the capacity to expand across a large proportion of northern and central Australia.

Policy

National Strategy:

Buffel Grass is not classified as a Weed of National Significance, therefore there is no National Strategy for this species.

State Policy:

Buffel Grass is a declared species under the *Natural Resources Management Act,* 2004.

Buffel grass contained and its impacts on native vegetation, grazing systems, remote communities and infrastructure in South Australia minimised.

Objectives:

• Vulnerable sites currently free of buffel grass protected from invasion.

• Buffel grass contained within its present range in South Australia, and this range incrementally reduced where possible.

• Buffel grass infestations are removed from key dispersal nodes and pathways.

• Natural and built assets protected from the fire risk associated with buffel grass infestations.

Regional Implementation:

See NRM Act, 2004 or *SA Buffel Grass Strategic Plan 2012-2017* for details.

SA Arid Lands NRM Policy:	The SAAL NRM Board management strategy is to PROTECT sites from the spread of Buffel Grass Aim: To prevent spread of Buffel Grass to key sites/assets of high economic, environmental and/or social value.
Kingoonya NRM District Risk management strategy:	Kingoonya NRM District management strategy is to PROTECT sites from the spread of Buffel Grass Aim: To prevent spread of Buffel Grass to key sites/assets of high economic, environmental and/or social value.

Kingoonya NRM District Strategy for management of Buffel Grass

Recommended Actions
Support land manager education in identification, monitoring and control of Buffel Grass.
Kingoonya NRM District Group to encourage landholders to provide data on distribution of Buffel Grass in Kingoonya NRM District to NRSAAL, so that it can be surveyed and mapped.
Kingoonya NRM District group to provide input into identification of key sites requiring control of Buffel Grass.
Kingoonya NRM District group to assist in identifying and coordinating Buffel Grass control programs using integrated weed management (combination of recommended best practices), especially in areas where key sites are threatened.
Land managers encouraged to monitor success, following control of Buffel Grass, and carry out follow up control as necessary.
Introductions and movement of Buffel Grass are to be restricted within SAAL NRM Region.

Best Practice Control

Control method and description	**Best time to control**	**Active ingredients and example trade names**	**Herbicide rates and carrier**
Foliar Spray			
Spray all sides of the entire plant. Ensure the entire plant is covered in the herbicide mix. Spot spraying with a knap sack or quad/ute mounted spray unit can be used for scattered occurrences. Boom spray can be used for dense infestations where no native vegetation exists between Buffel Grass plants e.g. along roads. Buffel Grass can quickly regenerate from seed and ongoing monitoring and control is required after warm season rain.	Between 2-4 weeks after warm season rain	Glyphosate (450g/L) e.g. *Roundup*® + Flupropanate (745g/L) e.g. *Tussock*	260 mL + 300mL / 100L water with a penetrant e.g. *Pulse*® It is also recommended that a dye is used with the herbicide mix to show which plants have been sprayed.
Physical			
Burning dried-out Buffel Grass allows for better control from chemical spraying when plant re-shoots after rain (e.g. better coverage of new foliage). Grubbing can be used for isolated occurrences or small infestations. Dig the entire plant out of the ground. Ongoing monitoring and follow up hand pulling/grubbing will be required annually.			

Surveys/ Monitoring

General method:	Keep an eye out for Buffel Grass during routine pastoral management activities and record locations using a GPS. Especially look in areas adjacent to roads where the soil has been disturbed.
Best time of year for surveys:	In the weeks following rainfall, look for a large clumpy grass with often purple or black seed heads.

Cactus species

The major species weed species of Cactus in South Australia are Coral Cactus (*Austrocylindropuntia* cylindrica), Devil's Rope cactus (*Cylindropuntia imbricata*), Drooping Prickly Pear (*Opuntia vulgaris/monacantha*) [not discussed], Hudson Pear (*Cylindropuntia rosea*), Jumping Cholla (*Cylindropuntia prolifera*), Engelmann's Prickly Pear (*Opuntia engelmannii*), Prickly Pear (*Opuntia stricta*) and Wheel Cactus (*Opuntia robusta*).

Common name(s):	**Coral Cactus**
Scientific name:	*Cylindropuntia fulgida var. mamillata*
Plant description:	Cactus, 1-1.5 m high (occasionally 3 m). Upper segments are smooth greyish to dark green, 6-70 cm long x 1-5 cm wide. Segments resemble coral as they mature. Spines (1-6) emerge from depressions, with white woolly hairs and minute bristles. Flowers, dull red 2-3.5 cm diameter. Fruit of Coral Cactus is yellow-green, spiny, barrel shaped.

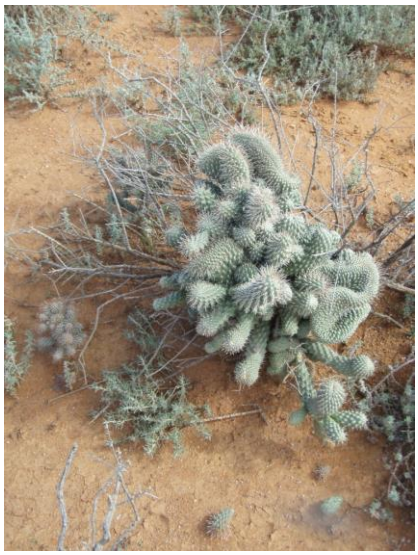

Photo 12: Coral Cactus plant (Photo B Shepherd)

Photo 13: Mature Coral Cactus plant (Photo B Shepherd)

Flowering:	late spring - summer
Origin:	Ecuador and Peru
When introduced:	Unknown
Why introduced:	unknown
Other information:	Floodwaters may damage plants, and also disperse segments resulting in new infestations.

Common name(s):	**Devil's Rope cactus**
Scientific name:	*Cylindropuntia imbricata*
Plant description:	Cactus, 1-2 m high (occasionally 3 m) often with a woody trunk. The plant is made up of strong woody segments dark to grey-green which are rope like in appearance. Sharp spines (2-30) emerge from depressions in segments, spines, 2-3 cm long, enclosed in yellow bristles. Flowers are 3-7.5 cm diameter, purple or purplish-red. The fruit of Devil's Rope cactus is usually spineless, barrel shaped and matures to a yellow colour.

Photo 14: Rope like appearance of Devil's Rope cactus (Photo J Pitt)

Photo 15: Purple flowers of Devil's Rope cactus (Photo J Pitt)

Flowering: late spring - summer
Origin: Southern USA and Mexico
When introduced: unknown
Why introduced: As an ornamental garden plant
Other information: Previously called *Opuntia imbricate*

Common name(s): **Jumping Cholla**
Scientific name: *Cylindropuntia prolifera*

Cactus to 2m high. Segments are grey-green up to 15 cm long and 5 cm wide. Segment depressions contain 6-12 spines up to 2 cm.

Flowers rose to magenta, to 4 cm diameter.

Fruit 2–4 cm long, 2–3 cm wide, spineless occasionally in short chains.

Photo 16: Jumping Cholla plant (Photo R Holtkamp)

Photo 17: Magenta flower of Jumping Cholla (Photo R Holtkamp)

Flowering: spring–early summer
Origin: USA and Mexico
When introduced: 1993 (1st record in NSW)
Why introduced: unknown

Common name(s): **Hudson Pear**
Scientific name: *Cylindropuntia rosea*
Plant description: ***Cylindropuntia rosea*** **(Hudson Pear)** – much branched Cactus, 1.5 m high, to 3 m wide. Segments are cylindrical up to 90 cm long and 4 cm wide. Segment depressions contain clusters of 4-8 spines, up to 3.5 cm. Pink flowers to 5 cm diameter. The fruit is wider towards the tip, 2 - 4.5 cm long.

Photo 18: Hudson Pear cactus (Photo G Patrick)

Photo 19: Pink flowers of Hudson Pear

Flowering: late spring and summer
Origin: Mexico
When introduced: 1960s
Why introduced: As an ornamental garden plant

Common name(s): **Engelmann's Prickly Pear**
Scientific name: *Opuntia engelmannii*
Plant description: Cactus, 2m tall. Upper segments are dull mid to grey-green and oval to circular shaped (9-26 cm long). Segment depressions contain 1-12 spines, with brown woolly hairs and short yellow-brown bristles.

Yellow flowers.

The fruit is pear to barrel shaped, spiny, and maturing to reddish-purple.

Photo 20: Engelmann's Prickly Pear (Photo B Shepherd)

Photo 21: Oval to circular segments of Engelmann's Prickly Pear (Photo B Shepherd)

Flowering: unknown
Origin: Mexico and USA
When introduced: unknown
Why introduced: Unknown

Common name(s): **Wheel cactus**
Scientific name: *Opuntia robusta*
Plant description: Cactus, usually 1-2 m tall, occasionally to 4 m generally with a well-developed trunk. Segments are circular, bluish green to bluish grey to 40 cm diameter. Segment depressions are widely spaced containing 1-12 spines, 5 cm long with brown woolly hairs and yellow to brown bristles.

Flowers are yellow ageing to white, 5-8cm diameter.

The fruit is pink to purple, barrel shaped to 8 cm long and 6cm diameter.

Photo 22: Wheel Cactus plants (Photo J Pitt)

Photo 23: Oval to circular segments of Wheel Cactus (Photo J Pitt)

Flowering: Unknown

Origin: Mexico

When introduced: unknown

Why introduced: As an ornamental or botanical curiosity

Other information: The native habitat of Wheel Cactus is rare and endangered and is listed on the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

Common name(s): **Prickly Pear**

Scientific name: *Opuntia stricta*

Plant description: Cactus, 0.5-1m tall, 0.5-5m across. The basal stem segments often thicken and form a trunk. The upper stem segments are dull mid to grey-green and oval shaped. Segment depressions are usually spineless or contain 1-11 spines (1-6 cm long) with brownish woolly hairs and short yellow bristles.

Flowers are yellow, 5-8 cm wide

The pear shaped fruit is smooth and purple at maturity.

Photo 24: Prickly Pear plant (Photo G. Patrick)

Photo 25: Yellow flowers of Prickly Pear (Photo T Bowman)

Photo 25: Yellow flowers of Prickly Pear (Photo T. Bowman)

Flowering: Summer

Origin: Drier tropical and sub-tropical America

When introduced: prior to 1839

Why introduced: As an ornamental garden plant or for use as food for cochineal insects which were used to produce dye for soldiers' coats.

Other information: Plants may still establish from segments of Prickly Pear following disposal of garden waste unless buried to a depth of greater than 1 metre

Threats and Impacts

Invasiveness

Wheel Cactus, Prickly Pear and Engelmann's Prickly Pear are highly invasive. They have high seed production, reproduce vegetatively, seeds are dispersed by birds and other animals and seedlings establish easily. Flood events have also been observed to promote spread of cacti species.

Devil's Rope cactus, Jumping Cholla and Coral Cactus are also invasive species well adapted for vegetative spread and able to withstand drought conditions.

Impacts

At high density, infestations of cacti species can render land unsuitable for grazing as thickets exclude livestock and can degrade biodiversity as the infestations outcompete native plants and reduce habitat for native fauna.

Persistence

The ability of cacti to recover from control is very high. Re-establishment is assisted by the longevity of seed stored in the soil and the fact that new plants can grow from untreated or dropped pads. Follow up control is essential.

Distribution

Current Australian distribution:

Cacti species are common throughout Australia, both in gardens and as naturalised plants. In most states one or several Cactus species are declared weeds.

Current South Australian distribution:

There are significant infestations of Prickly Pear and Wheel Cactus near Peterborough, Terowie, along the River Murray cliffs, in the Blinman Parachilna area of the Flinders Ranges and around Port Augusta.

There is an infestation of Engelmann's Prickly Pear in the Flinders Ranges north of Quorn which is often confused with Wheel cactus.

Devil's Rope Cactus occurs to a lesser extent in these areas as well as in other areas around northern South Australia, primarily in the mid north agricultural district, the Flinders Ranges and the Olary Ranges.

There are three sites – two east of Coober Pedy and one in the North Flinders - where Coral Cactus and/or Jumping Cholla have naturalised and are spreading, however these populations are small and manageable. It is likely that these are not the only occurrences Coral Cactus and Jumping Cholla in northern South Australia and that others exist possibly in abandoned gardens or around ruins.

Hudson Pear occurs near Port Augusta and Whyalla.

Current District distribution:

There are no extensive infestations of cactus species in the Kingoonya District however various species of cactus exist in a number of station gardens and or within towns (e.g. Woomera) and some of these populations are spreading.

Potential distribution:

Cacti species have the potential to establish across most of the arid and semi-arid areas of South Australia.

Policy

National Strategy:

Opuntia (Cacti) species are classified as Weeds of National Significance. The Strategic Plan aims to deliver the following goals and objectives:

- New infestations are prevented from establishing.
- Established infestations are under strategic management.
- Greater capability and commitment to manage opuntioid cacti.

State Policy:	To prevent Opuntia1 species from competing with more desirable plants and restricting access in the pastoral areas of the State. Under the Natural Resources Management Act, 2004: • Prohibiting movement of Opuntia species on public roads and entry into SA; • Prohibiting sale of Opuntia species or their seeds, or contaminated material; • Requiring landowners to destroy Opuntia species on their properties; and • Allowing recovery of costs of Opuntia species control on road reserves.
SA Arid Lands NRM Policy:	The SAAL NRM regional management strategy for Opuntia species is to CONTAIN SPREAD Aim: To prevent the spread of Opuntia through control of all infestations. The SAAL NRM regional management strategy for Cylindropuntia species is to DESTROY INFESTATIONS Aim: To significantly reduce the extent of Cylindropuntia spp. in the SA Arid Lands.
Kingoonya NRM District management strategy:	To CONTAIN SPREAD of Prickly Pear, Engelmann's Prickly Pear and Wheel cactus. Aim: To prevent the spread of Prickly Pear, Engelmann's Prickly Pear and Wheel Cactus through control of all infestations. To DESTROY INFESTATIONS of Devil' Rope, Jumping Cholla, Coral Cactus and Hudson Pear. Aim: To significantly reduce the extent of Devil's Rope, Jumping Cholla, Coral Cactus and Hudson Pear in the Kingoonya NRM District through destruction of known infestations.

Kingoonya NRM District Strategy for management of Opuntia species

Recommended Actions
Support land manager education in identification, monitoring and control of Opuntia species.
Kingoonya NRM District Group to encourage landholders to provide data on Opuntia infestations in Kingoonya NRM District to NRSAAL, so that it can be surveyed and mapped.
Kingoonya NRM District group to provide input into identification of key sites requiring control of Opuntia species.
Kingoonya NRM District group to assist in identifying and coordinating Opuntia control programs using integrated weed management (combination of recommended best practices), especially in areas where key sites are threatened.
Land managers to undertake control of all Opuntia species in close proximity to key sites.
Land managers encouraged to monitor success, following control of Opuntia, and carry out follow up control as necessary.
Sale and movement of all Opuntia species to be restricted within SAAL NRM Region.

[1] The authors of this report interpret '*Opuntia* species' to collectively refer to the weedy Cactus species including *Austrocylindropuntia, Cylindropuntia* and *Opuntia.*

Best Practice Control

Following initial control of mature cactus plants, cactus seeds deposited under mature plants and pads that were missed or dropped off during treatment will germinate and grow, therefore follow up monitoring and control around mature plants is required for several years.

Control method and description	Best time to control	Active ingredient and example herbicide	Herbicide rates and carrier
Foliar spray			
Useful for all cacti species. Suitable for larger infestations. Spray all sides of every cactus pad until chemical runs off. Spray only when cacti are green and healthy.	Any time of year providing plants are not stressed and actively growing.	Triclopyr (600g/L) e.g. *Garlon*®	33 ml/L water with Spray oil e.g. Hotwire® or 33 ml/L diesel
		Triclopyr (240g/L) + Picloram (120g/L) e.g. *Access*®	17 ml/L diesel
Useful for all cacti species. Suitable for larger infestations. Spray all sides of every cactus pad until chemical runs off. Spray only when cacti are green and healthy.	Apply in summer above 30^{o}	Triclopyr (240g/L) + Picloram (120g/L) e.g. Grazon	50ml/10 L water
		MSMA (800g/L MSMA) e.g. Daconate	1 L/40 L water
Stem inject			
Useful for most cactus species. Suitable for isolated plants or small infestations. Inject a measure of herbicide into each cactus stem or in at least every 4th pad utilising a Velpar® gun and injecting lance. Following control, seeds deposited under mature plants and pads that were missed or dropped off during treatment will germinate and grow, so follow up monitoring and control around mature plants is required for several years.	Any time of year	Glyphosate e.g. *Roundup*®	Inject 2-4ml of neat Glyphosate into each stem or every 4th pad.
Biological			
Cochineal scale (Dactylopius spp.) may be used as a biological control for various Opuntia and Cylindropuntia species including Engelmann's Prickly Pear, Hudson pear, Prickly pear, Wheel Cactus and Devil's rope. The scale appears as small white cotton wool spots across the cactus pads. Juvenile and adult females suck fluid from plant tissues and in high enough densities energy production may be impacted and the plant's growth is restricted or the plant may die. Pads from infected plants may be removed and wedged low on a new host plant, protected from rain where possible, with the most heavily infested surface as close as possible to the surface of the new host plant. This will allow for movement of wingless cochineals to the new host plant.			
Physical			
It is possible to dig out cacti but care must be taken due to their spines. This is only practical for small isolated plants. Care must be taken not to drop any segments, as these may grow and develop into new plants. Material must be disposed of via deep burial. This method may be used all year round.			
Fire			
Hot fires may kill plants but regrowth may occur, requiring follow-up control. Burning can assist in accessing large infestations allowing use of other control activities. This method may not be practical where cacti are growing amongst native vegetation. Note: Do not burn on days of high fire danger.			

Photo 26: Control of Coral Cactus using foliar spray (Photo B Shepherd)

Surveys/ Monitoring

General method:	Keep an eye out for cactus plants during routine pastoral management activities and record location using a GPS. Look for old plantings of cactus in historic gardens around ruins, railway sidings and other areas associated with human settlement.
Best time of year for surveys:	Any time of year

Innocent Weed

Common name(s): Innocent Weed/Spiny Burr-grass

Scientific name: *Cenchrus longispinus* and *Cenchrus incertus*

Plant description: ***Cenchrus longispinus*** **(Innocent Weed)**, annual grass to 70 cm. Leaves narrow 1-6 mm wide, 3-15 cm long, with a reddish or purplish tinge.

Seed head has 8-18 'burrs', 3-12 mm across, with 40-70 sharp spines (3.5-7 mm long). 'Burrs' are reddish or purplish-green when young but mature to a straw colour or brown. The 'burrs' are on stalks 1-5 mm long.

Seeds are egg shaped, 2-4 mm long, 2-3 mm wide.

Photo 27: Innocent Weed plant (Photo A Harvey)

Photo 28: Innocent Weed seed heads (Photo A Harvey)

Cenchrus incertus **(Spiny Burr-grass)**, annual and occasionally perennial grass to 60cm tall. Leaves narrow 2-8mm wide to 2-20cm long.

The seed-head has up to 40 'burrs', 3-10 mm across, with 8-45 sharp spines (2-5mm long). 'Burrs' are purplish-green when young but mature to a straw colour or brown.

Seeds are egg shaped, 2-4mm long, 2-3mm wide

Flowering: Summer and autumn

Origin: North and Central America

When introduced: 1886

Why introduced: Unknown

Other information: *Cenchrus longispinus* and *Cenchrus incertus* can be confused with each other and other *Cenchrus* species. Species are distinguished by their 'burrs'.

Threats and Impacts

Invasiveness Innocent Weed is readily spread by dispersal of its 'burrs' (which contain the plants' seeds), as they attach to animals, vehicles and clothing. 'Burrs' may also be distributed by water and contaminated agricultural produce, especially hay. A weed of disturbed sites such as roadsides, pastures and cultivated areas.

Seedlings have been known to establish from seed deeply buried (to 25 cm) in sandy soils.

Impacts	Innocent Weed can become tangled in wool, as a result wool is devalued and animals are more difficult to handle. The 'burrs' may also cause ulcers in the mouths of grazing animals.
Persistence	Innocent Weed does not establish well in pastures, particularly when there are competitive pasture species present. 'Burrs' lying on the soil surface do not readily germinate (due to low moisture and also inhibiting effect of light), but buried seeds germinate more easily, requiring ongoing control.

Distribution

Current Australian distribution:	Innocent Weed is widespread throughout the Murray Mallee and irrigated areas along the Murray River of both Victoria and South Australia. It is common in coastal Queensland and is found in small isolated areas of the Northern Territory and Western Australia.
Current South Australian distribution:	In South Australia, it has been found on the Eyre Peninsula, northern pastoral and agricultural districts, and in isolated patches of the South East. Major infestations are in the Riverland irrigation areas, the Northern Murray Mallee dry land areas and in urban areas.
Current District distribution:	Known in the Kingoonya district around Roxby Downs, however there is no spatial data of these occurrences.
Potential distribution:	Innocent Weed has the potential to establish throughout most of the semi-arid areas of South Australia.

Policy

National Strategy:	Innocent Weed is not classified as a Weed of National Significance, therefore there is no National Strategy for this species.
State Policy:	To prevent Innocent Weed being introduced to areas free of the plant especially urban areas, areas with sandy soils and irrigation areas. Under the Natural Resources Management Act, 2004: ▪ Prohibiting movement of Innocent Weed on public roads. ▪ Prohibiting sale of Innocent Weed or produce or goods carrying the plant. ▪ Requiring land owners to control Innocent Weed on their properties. ▪ Allowing recovery of costs of roadside control of Innocent Weed. ▪ Requiring notification of Innocent Weed infestations to NRM authority.
SA Arid Lands NRM Policy:	The SAAL NRM Board management strategy is to PROTECT sites from the spread of Innocent Weed. Aim: To prevent spread of Innocent Weed to key sites/assets of high economic, environmental and/or social value.
Kingoonya NRM District management strategy:	Kingoonya NRM District management strategy is to PROTECT sites from the spread of Innocent Weed Aim: To prevent spread of Innocent Weed to key sites/assets of high economic, environmental and/or social value.

Kingoonya NRM District Strategy for management of Innocent Weed

Recommended Actions
Support land manager education in identification, monitoring and control of Innocent Weed.
Kingoonya NRM District Group to encourage landholders to provide data on distribution of Innocent Weed in Kingoonya NRM District to NRSAAL, so that it can be surveyed and mapped.
Kingoonya NRM District group to provide input into identification of key sites requiring control of Innocent Weed.
Kingoonya NRM District group to assist in identifying and coordinating Innocent Weed control programs using integrated weed management (combination of recommended best practices), especially in areas where key sites are threatened.
Land managers encouraged to monitor success, following control of Innocent Weed, and carry out follow up control as necessary.
Introductions and movement of Innocent Weed are to be restricted within SAAL NRM Region

Best Practice Control

Control method and description	Best time to control	Active ingredients and example trade names	Herbicide rates and carrier
Foliar Spray			
Useful on all plants Spray the entire plant with the recommended herbicide mixture when it is actively growing and before seed set, i.e. within the first week after summer rainfall.	Within 1 week after summer rain	Glyphosate (360g/L) e.g. *Roundup*®	10 ml/1L in water with penetrants e.g. *Pulse*®
Physical			
Isolated occurrences of Innocent Weed can be easily grubbed out of the ground within 1 week after rain. Grub the plant(s) out of the ground prior to seed set.			

Surveys/ Monitoring

General method:	Keep an eye out for Innocent Weed during routine pastoral management activities, especially around stock yards.
Best time of year for surveys:	Immediately after summer rainfall.

Khaki Weed

Common name(s): Khaki Weed

Scientific name: Alternanthera pungens

Plant description: Prostrate herb with perennial root system and annual above ground growth. Taproot often large, woody and deep-penetrating.

Stems shortly silky hairy. Leaves ovate to circular, hairless to sparsely hairy, margins entire; leaf stalk 0.2–1 cm long. Inflorescence ovoid, 6–10 mm wide.

Fruit 1–1.5 mm long. Seeds about 1 mm wide, brownish, globe-shaped. It forms carpets of sharp burrs that can injure people and animals.

Photo 29: Khaki Weed runners (Photo weeds.org.au)

Photo 30: Khaki Weed with burrs (Photo depi.vic.gov.au)

Flowering: March to April

Origin: Native of Brazil, Ecuador, Peru and Venezuela. It has become widely distributed through the temperate and tropical regions of the world.

When introduced: First recorded in NSW in 1898. First noticed around Alice Springs in 1957.

Why introduced: Unknown. Probably by accident on introduced stock.

Other information:

Threats and Impacts

Invasiveness Spread by seed within spiny bracts that adhere to tyres, clothing and animals. Local spread may also occur through spreading stems that root at nodes. Cultivation can also encourage spread.

Impacts Major weed of warm temperate and tropical areas around the world. Stock graze young plants. Widespread in wasteland, caravan parks, orchards and recreation areas. The sharp spiny fruit cause mechanical damage to the feet and mouths of stock and working animals when present in hay and pasture.

Khaki Weed is believed to be poisonous to animals and to cause skin ailment in cattle. It is not readily eaten but sometimes young plants are consumed by sheep, apparently without ill effect (Parsons & Cuthbertson 2001). It is also claimed to cause hay fever, asthma and dermatitis in some people.

Persistence

Khaki Weed is a difficult plant to control as it is deep-rooted, the tap root also allowing it to survive periods of drought. It also forms a soil seed-bank under infestations, with seed surviving for more than 5 years.

Distribution

Current Australian distribution:

Khaki Weed occurs in all mainland states and territories. In New South Wales it occurs in towns in a broad band running north to south through the state and Australian Capital Territory, in coastal areas north of Sydney and also agricultural regions in the central and north-west of the state.

In Victoria and South Australia, Khaki Weed is confined to towns in the more arid areas. It is widespread in Queensland particularly around towns in the south-east (Parsons & Cuthbertson 2001).

In the Northern Territory, it occurs in the Darwin, Gulf, Katherine, Victoria River and Alice Springs districts (Miller & Schultz 1997).

In Western Australia, Khaki Weed can be found in and around towns in the Kimberley and Pilbara regions and around Perth and other centres in the south-west (Spooner *et al.* 2007).

Current South Australian distribution:

Records of Khaki Weed infestations are scattered in the Eyre Peninsula, Northern and Yorke, Kangaroo Island, SA Murray Darling Basin and South East regions, extending as far north as Marla in the pastoral zone. Many of these have been eradicated but its distribution is maintained by annual incursions on vehicles.

Current District distribution:

Plants have been found in the Bon Bon Rest Area on the Stuart Highway (2010) and in Roxby Downs township (2012).

Potential distribution:

Khaki Weed likes light soils and relies on summer rainfall, so providing these conditions are met, Khaki Weed can exist throughout mainland Australia. Due to its spiny seeds, it can easily be picked up on vehicle tyres and spread anywhere vehicles travel.

Policy

National Strategy:

Khaki Weed is not classified as a Weed of National Significance, therefore there is no National Strategy for this species.

State Policy:

No losses to the amenity value of recreational land or pasture production due to Khaki Weed.

Objectives:

- Detect and destroy all Khaki Weed infestations
- Prevent further spread and establishment in SA.

Implementation

- Biosecurity SA and NRM authorities to promote awareness of alert weeds including Khaki Weed.
- Landowners to report infestations to NRM authorities.
- NRM authorities to inspect camping grounds, ovals, roadhouses and roadside reserves for Khaki Weed.
- Landholders to destroy infestations growing on land they occupy.
- NRM authorities to ensure all infestations on public or private land are destroyed.
- NRM authorities to destroy infestations on road reserves as detected.

SA Arid Lands NRM Policy:	SAAL NRM regional management strategy for Khaki Weed is to PROTECT SITES. Aim: To prevent spread of Khaki Weed to key sites/assets of high economic, environmental and/or social value.
Kingoonya NRM District management strategy	Kingoonya NRM District management strategy for Khaki Weed is to DESTROY INFESTATIONS. Aim: To significantly reduce the extent of Khaki Weed in the Kingoonya District.

Kingoonya NRM District Strategy for management of Khaki Weed

Recommended Actions

Support land manager education in identification, monitoring and control of Khaki Weed.

Kingoonya NRM District Group to encourage landholders to provide data on distribution of Khaki Weed in Kingoonya NRM District to NRSAAL, so that it can be surveyed and mapped.

Kingoonya NRM District group to provide input into identification of key sites for control of Khaki Weed infestations.

Kingoonya NRM District group to assist in identifying and coordinating Khaki Weed control programs using integrated weed management (combination of recommended best practices), especially in areas where key sites are threatened.

Land managers encouraged to control Khaki Weed whenever found.

Land managers are encouraged to monitor success, following control of Khaki Weed, and carry out follow up control as necessary.

Best Practice Control

Control method and description	Best time to control	Active ingredients and example trade names	Herbicide rates and carrier
Foliar Spray			
Spot spraying with a knap sack or quad/ute mounted spray unit can be used Spray the entire plant with the recommended herbicide mix. Soil residual. Do not use near desirable vegetation or in waterways.	Anytime	2,4-D (300g/L) + picloram (75g/L) e.g. Tordon® 75-D	650ml/100L water
Spot spraying with a knap sack or quad/ute mounted spray unit can be used Spray the entire plant with the recommended herbicide mix Non-selective, avoid contact with desirable plants. Won't kill the root system, ongoing treatment required.	Whilst plant actively growing	Glyphosate (450g/L) e.g. Roundup®	1L/100L water
Fallow. Boom spray. DO NOT treat weeds which are beyond the rosette stage. Use higher rate on large weeds. DO NOT HARVEST, GRAZE OR CUT FOR STOCK FOOD FOR 7 DAYS AFTER APPLICATION.	Apply when weeds have at least 3-5 true leaves and are actively growing.	Dicamba (500g/L) Kamba 500®	320-560ml/ha
Physical			
Individual plants may be grubbed. Ensure the complete removal of the tuber and root system. Dig beside the root 100mm down or more. Destroy any burrs found.			

Surveys/ Monitoring

General method:	Keep an eye out for Khaki Weed during routine pastoral management activities and record locations using a GPS or farm map.
Best time of year for surveys:	Spring through to autumn.

Mesquite

Common name(s): Mesquite

Scientific name: *Prosopis* species

Plant description: Mesquites are a group of shrubs or small trees, which reproduce by seed and suckers. Leaves are fern-like, often with one or two thorns.

Flowers are greenish-yellow, small, arranged on cylindrical-shaped flower heads 50-80 mm long.

Seed pods (up to 20 cm long) are generally straight or slightly curved, and resemble a string of beads.

Photo 31: Mature Mesquite tree (Photo B Shepherd)

Photo 32: Fern like leaves of Mesquite (Photo B Shepherd)

Photo 33: Greenish-yellow flowers of Mesquite (Photo B Shepherd)

Flowering: Spring to early summer

Origin: USA and Mexico

When introduced: 1900

Why introduced: As ornamental, fodder and shade trees

Other information: There are some 44 species of *Prosopis*, only a few have been introduced to Australia.

Threats and Impacts

Invasiveness

The South Australian occurrences of Mesquite are on the outer extent of their preferred range and it tends not to spread as rapidly as in the northern Australian climate. However, vigorous establishment and growth of the South Australian populations demonstrate its potential to successfully invade and establish. Mesquite reproduces from seeds that are readily eaten and dispersed by animals.

Impacts

Mesquite forms dense thickets that prevent stock from accessing water points and make mustering difficult. The thickets overrun grazing land, exclude all other vegetation and use valuable ground water.

Persistence

Mesquite will grow in most of the semi-arid and arid environments of northern South Australia however it prefers areas prone to flooding or where soil moisture is retained. Mesquite is a very hardy plant that can tolerate dry conditions and seeds remain viable for several years.

Distribution

Current Australian distribution:

Mesquite occurs in every mainland state. In the semi-arid and arid areas of Queensland and Western Australia Mesquite has infested large tracks of pastoral country.

Current South Australian distribution:

Mesquite was infrequently planted in gardens around South Australia. There are four known naturalised populations of Mesquite in northern South Australia, in the eastern districts around Cockburn, around Woomera, on the south eastern side of Lake Torrens and another near Port Augusta. All Mesquite populations are demonstrating vigorous regenerating. These are being actively and successfully suppressed.

Current District distribution:

The largest population of Mesquite occurs in areas around Woomera. In June 2014 several hundred plants, 1 to 2 metres high, were identified north of the Woomera township along the Pimba Road and tributaries of Wirrawirralu Creek. Historic records of Mesquite exist at Kingoonya, Tarcoola and along the Stuart Highway. All these have been successfully treated.

Potential distribution:

Mesquites combination of a long life cycle, ability to survive droughts, high seed production and long seed life makes it well suited to establishment in northern SA. Mesquite has the ability to establish in the rivers, swamps and other areas where soil moisture persists, throughout northern SA.

Policy

National Strategy:

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

State Policy:	To maintain production from semi-arid pastoral lands and protect the integrity of native vegetation. Under the *Natural Resources Management Act*, 2004: ▪ Prohibiting entry of Mesquite into SA and movement on public roads. ▪ Prohibiting sale of Mesquite or contaminated material. ▪ Requiring landholders to notify NRM authority of Mesquite infestations. ▪ Requiring landholders to destroy Mesquite on their properties. ▪ Allowing NRM authorities to recover costs for roadside control of Mesquite. It is legislated that, in all parts of South Australia: ▪ Landholders have the responsibility to destroy Mesquite on their land. ▪ Landholders have the responsibility to notify NRM authority of Mesquite infestations. ▪ Landholders have the responsibility to notify NRM authority of Mesquite infestations. ▪ Landholders have the responsibility to notify NRM authority of Mesquite infestations. • NRM authorities have the responsibility to destroy Mesquite on road reserves, and may recover the cost of this work from the adjoining landholders.
SA Arid Lands NRM Policy:	The SAAL NRM regional management strategy for Mesquite is to DESTROY INFESTATIONS. Aim: To significantly reduce the extent of Mesquite in the region.
Kingoonya NRM District management strategy	Kingoonya NRM District management strategy is to DESTROY INFESTATIONS. Aim: To significantly reduce the extent of Mesquite in Kingoonya NRM District.

Kingoonya NRM District Strategy for management of Mesquite

Recommended Actions
Support land manager education in identification, monitoring and control of Mesquite
Kingoonya NRM District Group to encourage landholders to provide data on infestations of Mesquite in Kingoonya NRM District to NRSAAL, so that it can be surveyed and mapped.
Destruction of all Mesquite from the Kingoonya NRM District including removal of cultivated plants.
Land managers encouraged to monitor success, following control of Mesquite, and carry out follow up control as necessary.
Kingoonya NRM District to consider quarantine provisions around known occurrences of Mesquite.
Sale and movement of Mesquite to be prevented within SAAL NRM Region.

Best Practice Control

Control method and description	**Best time to control**	**Active ingredients and example trade names**	**Herbicide rates and carrier**
Basal Bark			
Useful for smaller to mid sized plants that have not developed rough bark. Spray all sides of each stem with the recommended herbicide mix, from the ground up to a height of between 500 - 750mm.	Most of the year assuming the plant is not stressed. Most effective	Triclopyr (240 g/L) + Picloram (120 g/L) e.g. *Access*®	17 mls/L mixed in diesel

Control method and description	Best time to control	Active ingredients and example trade names	Herbicide rates and carrier
For seedlings spray the entire plant.	when actively growing.		
Foliar Spray			
Best for seedlings & regrowth of previously treated areas on plants under 1.5m height Spray the entire plant	Best time to spray is when plants are actively growing and soil moisture is good.	Triclopyr 300g/l plus Picloram (salt) 100g/l e.g. *Grazon*®	350 mL/100 L water. Add a 100% concentrate non-ionic surfactant e.g. BS 1000 at 100mL/100L
Cut Stump			
Useful for medium to larger trees The main stem(s) are cut off by chainsaw and the stump immediately (within 10 seconds) painted or sprayed with the recommended herbicide mixture. The stump should be cut as close to the ground as possible.	Any time of year	Triclopyr (240 g/L) + Picloram (120 g/L) e.g. *Access*®	17 mls/L mixed in diesel
Physical			
Useful for very large trees, dense infestations and broad scale germination or regrowth. The entire plant is removed from the ground using a suitable bulldozer or loader. Roots must be cut about 30-50 cm below the soil surface to reduce the incidence of regrowth. This is best done with a blade plough. Branch and root fragments of Mesquite can take root, therefore woody material must be moved out of creek lines and moist areas. Ongoing inspections and hand-pulling of seedlings will additionally be required where recruitment is occurring, until the seedbank is exhausted.			

Surveys/ Monitoring

General method: Keep an eye out for Mesquite during routine pastoral management activities and record locations using a GPS.

Best time of year for surveys: Any time of year, look for fern like leaves, long yellow flower heads and the (sometimes) bright light green leaves.

Parkinsonia

Common name(s): Parkinsonia

Scientific name: *Parkinsonia aculeata*

Plant description: Parkinsonia is a much branched shrub or tree, 2-8 m tall but at times reaching 10 m tall. Parkinsonia has extensive surface roots and a deep taproot.

Leaves consist of a flat, green leaf stalk (up to 30 cm long) with numerous pairs of small oval leaflets, often with a sharp spine (3-20 mm long)

Flowers are fragrant up to 2 cm diameter, bright yellow in colour becoming reddish with age. The top petal either has orange spots or turns completely orange.

The pod is almost straight (3-13 cm long and 3.5-8 mm wide), narrowing at each end.

Photo 35: The bright yellow flowers of Parkinsonia (Photo B Shepherd)

Photo 34: Parkinsonia tree (Photo B Shepherd)

Photo 36: Pods of Parkinsonia (Photo B Shepherd)

Flowering: Summer to early autumn

Origin: Central America

When introduced: 1890s and early 1900s

Why introduced: As a shade and ornamental shrub

Other information: Parkinsonia has the potential to invade more than three quarters of mainland Australia.

Threats and Impacts

Invasiveness

Parkinsonia reproduces by seeds that are spread by flood waters and in mud attached to vehicles or animals. It establishes and grows in a wide variety of conditions from semi-arid to sub-humid environments and prefers drainage lines, swamps, floodplains and other watered areas. Mature plants typically produce 5000 seeds annually, and germination after flood event or disturbance can be prolific.

Impacts

Parkinsonia forms dense thickets and can take over vast tracks of land replacing native plant species including valuable pasture species. It reduces access to land and water and increases difficulty when mustering stock. Parkinsonia reduces habitat for native species and provides a refuge for feral animals. The areas at risk are the more productive arid rivers and floodplains.

Persistence

Parkinsonia can re-shoot from roots. Germination from seed after control disturbance can be prolific. Parkinsonia seeds remain viable for many years.

Distribution

Current Australian distribution:

Parkinsonia was commonly planted in many areas around Australia in the late 1800s. Over one million hectares of Australia is now infested with Parkinsonia primarily throughout coastal, central and western Queensland, central and northern Northern Territory and the Kimberly and Pilbara regions of Western Australia.

Current South Australian distribution:

Within northern South Australia there are 3 current locations where Parkinsonia has naturalised – near Leigh creek in northern Flinders Rangers, around Woomera and Port Augusta. Historically there have been more occurrences recorded within gardens, however all of these have been successfully controlled.

Current District distribution:

Parkinsonia plants are being controlled at two locations in the district - at Woomera where there are naturalised plants in creek lines and on North Well station where an old planted Parkinsonia has been treated and the location is being monitored for new germinations.

Potential distribution:

Parkinsonia has the potential to establish in watercourses, swampy areas and other watered areas throughout arid and semi-arid areas of northern South Australia.

Policy

National Strategy:

Parkinsonia is confined and its impact reduced to a minimum

State Policy:

To maintain access to pastoral lands, and the integrity of native vegetation.

Under the *Natural Resources Management Act*, 2004:

- Prohibiting movement of Parkinsonia into SA.
- Prohibiting movement of Parkinsonia on public roads.
- Prohibiting sale of Parkinsonia, or produce or goods carrying Parkinsonia.
- Requiring notification of Parkinsonia infestations to NRM authorities.
- Requiring landholders to destroy Parkinsonia on their properties.
- Allowing recovery of costs of roadside control of Parkinsonia.

SA Arid Lands NRM Policy:

The SAAL NRM regional management strategy for is to PROTECT sites.

Aim: To prevent spread of Parkinsonia to key sites/assets of high economic, environmental and/or social value

Kingoonya NRM District management strategy:

Kingoonya NRM District management strategy is to ERADICATE Parkinsonia

Aim: To remove Parkinsonia from the Kingoonya NRM District.

Kingoonya NRM District Strategy for management of Parkinsonia

Recommended Actions
Support land manager education in identification, monitoring and control of Parkinsonia.
Kingoonya NRM District Group to encourage landholders to provide data on distribution of Parkinsonia in Kingoonya NRM District to NRSAAL, so that it can be surveyed and mapped.
Destruction of all populations of Parkinsonia in the Kingoonya NRM District.
Sale and movement of Parkinsonia is prohibited within SAAL NRM Region.
Land managers encouraged to monitor success, following control of Parkinsonia, and carry out follow up control as necessary.

Best Practice Control

Control method and description	Best time to control	Active ingredients and example trade names	Herbicide rates and carrier
Basal Bark			
Useful for smaller to mid sized plants that have not developed rough bark. Spray all sides of each stem with the recommended herbicide mix, from the ground up to a height of between 500 - 750mm. For seedlings spray the entire plant.	Most of the year assuming the plant is not stressed. Best when actively growing.	Triclopyr (240 g/L) + Picloram (120 g/L) e.g. *Access*®	17 mls/L mixed in diesel
Foliar Spray			
Best for seedlings & regrowth of previously treated areas on plants under 1.5m height Spray the entire plant	Best time to spray is when plants are actively growing and soil moisture is good.	Triclopyr 300g/l plus Picloram (salt) 100g/l e.g. *Grazon*®	350 mL/100 L water. Add a 100% concentrate non-ionic surfactant e.g. BS 1000 at 100mL/100L
Cut Stump			
Useful for medium to larger trees The main stem(s) are cut off by chainsaw and the stump immediately (within 10 seconds) painted or sprayed with the recommended herbicide mixture. The stump should be cut as close to the ground as possible.	Any time of year	Triclopyr (240 g/L) + Picloram (120 g/L) e.g. *Access*®	17 mls/L mixed in diesel
Physical			
Useful for very large trees, dense infestations and broad scale germination or regrowth. The entire plant is removed from the ground using a suitable bulldozer or loader. Roots must be cut about 30-50 cm below the soil surface to reduce the incidence of regrowth. This is best done with a blade plough. Branch and root fragments of Parkinsonia can take root, therefore woody material must be moved out of creek lines and moist areas. Ongoing inspections and hand-pulling of seedlings will additionally be required, where recruitment is occurring, until the seedbank is exhausted.			

Surveys/ Monitoring

General method:	Keep an eye out for Parkinsonia during routine pastoral management activities and record locations using a GPS.
Best time of year for surveys:	Any time of year, look for the distinctive small leaves and the overall bright light green colour of the plant.

Pepper Tree

Common name(s): Pepper Tree

Scientific name: *Schinus molle*

Plant description: A large evergreen tree to 12 m tall and 5-10 m wide. Leaves are divided into 15-41 alternatively arranged, shiny leaflets (to 4 cm long). Leaves are aromatic and sticky when crushed.

Small white flowers hang in long sprays, are followed by spherical shiny pink fruit (4-6 mm across).

Photo 37: Pepper Trees (Photo B Shepherd)

Photo 38: Immature fruit (Photo B Shepherd)

Photo 39: Mature pink fruit (Photo B Shepherd)

Flowering: All year round

Origin: South America

When introduced: 1870-1880 (listed for sale in nursery catalogues)

Why introduced: For shade

Other information: All *Schinus* species leaves and fruit are poisonous to livestock and possibly humans

Threats and Impacts

Invasiveness	Pepper Trees reproduce from seed, and germination requires sustained soil moisture. The seeds are dispersed by birds, animals, water and human activity. Broad scale seed germinations can occur following floods and favourable rainfall events, especially in swampy areas.
Impacts	Pepper Trees can form dense thickets in swamps and along rivers excluding native vegetation and using valuable ground water.
Persistence	Mature Pepper Trees can re-shoot following initial chemical control and can re-shoot from root portions left in the ground following mechanical control. Seeds remain viable for less than three years.

Distribution

Current Australian distribution:	Pepper Trees are favoured garden plants throughout Australia and there ability to withstand dry conditions makes them well suited as garden and shade plantings in arid and semi-arid areas.
Current South Australian distribution:	Pepper Trees are common at nearly every township, station house and stockyard in northern SA. Naturalised Pepper Trees are a common site, particularly along drainage lines of the Flinders Ranges, the Olary Ranges and in the mid north agricultural districts. Within some creeks and swamps, naturalised Pepper Trees are the dominant tree choking out all other plants.
Current District distribution:	Pepper Trees are planted at most station houses throughout the Kingoonya NRM district and there are some locations where they have naturalised along adjacent creek lines. There are significant infestations of Pepper Trees in the eastern areas of the district in creek lines north of Port Augusta.
Potential distribution:	Pepper Trees have demonstrated their ability to establish in many of the semi-arid drainage lines and swampy areas of South Australia.

Policy

National Strategy:	Pepper Trees are not classified as a Weed of National Significance, therefore there is no National Strategy for this species.
State Policy:	Pepper Trees are not a declared species under the *Natural Resources Management Act,* 2004, (therefore there is no South Australian policy).
SA Arid Lands NRM Policy:	The SAAL NRM Board currently management strategy is to MANAGE sites infested with Pepper Trees Aim: To maintain economic, environmental and/or social values of key sites/assets through improved management of Pepper Trees.
Kingoonya NRM District management strategy:	Kingoonya NRM District management strategy is to MANAGE sites infested with Pepper Trees Aim: To maintain economic, environmental and/or social values of key sites/assets through improved management of Pepper Trees.

Kingoonya NRM District Strategy for management of Pepper Tree

Recommended Actions
Support land manager education in identification, monitoring and control of Pepper Trees.
Kingoonya NRM District Group to encourage landholders to provide data on distribution of Pepper Trees in Kingoonya NRM District to NRSAAL, so that they can be surveyed and mapped.
Kingoonya NRM District group to provide input into identification of high priority areas such as significant rivers, creeks and waterholes and coordinate Pepper Tree control programs to protect identified priority sites.
Land managers encouraged to control naturalised Pepper Trees, and control cultivated Pepper Trees where key sites are threatened.
Land managers encouraged to monitor success, following control of Pepper Trees, and carry out follow up control as necessary.

Best Practice Control

Control method and description	Best time to control	Active ingredients and example trade names	Herbicide rates and carrier
Cut Stump			
Useful for medium to large trees The main stem(s) are cut off by chainsaw and the stump immediately (within 10 seconds) painted or sprayed with the recommended herbicide mixture. The stump should be cut as close to the ground as possible.	Any time of year	Triclopyr (240 g/L) + Picloram (120 g/L) e.g. *Grazon*® or *Access*®	17 mls/L mixed in diesel
Basal Bark			
Useful for smaller to mid sized plants that have not developed rough bark. Spray all sides of each stem with the recommended herbicide mix, from the ground up to a height of between 500 – 750 mm. For seedlings spray the entire plant.	Any time as long as plant not stressed. Most effective when actively growing.	Triclopyr (240 g/L) + Picloram (120 g/L) e.g. *Grazon*® or *Access*®	17 mls/L mixed in diesel.
Physical			
Useful for very large trees, dense infestations and broad scale germination or regrowth. The entire plant is removed from the ground using a suitably sized bull dozer or loader. Roots must be cut about 30-50 cm below the soil surface to reduce the incidence of regrowth. This is best done with a blade plough. Branch and root fragments of Pepper Trees can take root, therefore woody material must be moved out of creek lines and moist areas. Ongoing inspections and hand-pulling of seedlings will additionally be required where recruitment is occurring, until the seedbank is exhausted.			

Surveys/ Monitoring

General method:	Keep an eye out for naturalised Pepper Trees during routine pastoral management activities and record locations using a GPS.
Best time of year for surveys:	Anytime of year, look for the distinctive bi pinnate leaves and the overall light green colour of the plant.

Appendix 1 – Alert Weeds

The weeds identified in this section have not been sighted in the Kingoonya District. However, there have been infestations of them in neighbouring District(s) and the threat they pose are significant. They are included here to provide a reference for identification.

If you discover any of these plants in the Kingoonya District please contact Natural Resources SA Arid Lands (Ph. 8648 5300) immediately and report the location. Alternatively you can contact the Sustainable Landscapes Officer on 8648 5194 or 0417 738 498.

Bathurst Burr

Common name(s): Bathurst Burr

Scientific name: Xanthium spinosum

Plant description: Bathurst Burr is an erect, multi-branched annual herb, growing up to 1 m high (but usually 30–60 cm).

Leaves are dark green on the upper surface, a paler green on the under surface, up to 7 cm long and usually three-lobed.

Stems are branched with one or two three-pronged yellow spines at the base of each leaf stalk.

Flowers are creamy green and small, developing into straw-coloured burrs, 1–1.5 cm long, with numerous yellow hooked spines. Each burr contains two seeds.

Photo 40: Bathurst Burr with seed pods (Photo: Biosecurity Queensland)

Photo 41: Bathurst Burr close-up (Photo: Biosecurity Queensland)

Flowering: Summer generally but opportunistic when moisture is available.

Origin: South America

When introduced: Early 1800's

Why introduced: Accidently in contaminated grain or livestock imports

Threats and Impacts

Invasiveness

Heavy infestations occur where the ground has been disturbed, such as on roadsides, old cultivation paddocks and irrigated pastures or watercourses. It does not tolerate dense competition from other weeds or dense pasture. It has been widespread in the more marginal pasture areas for over a century, rarely incurring into areas of higher rainfall.

The hooked spines of Bathurst Burr will readily attach to the fur or wool of animals and other fibrous material (such as clothing), making burrs easy to disperse. Burrs are also able to float and can spread along watercourses.

Impacts

Its burrs are a major contaminant of fleeces in some years, especially when summer rainfall has been high. Seedlings are poisonous to domestic stock animals, especially horses and pigs, causing death in some circumstances.

Persistence

Of the two seeds present in each burr, only one will germinate in a single season. The other seed will remain dormant for two or three years (sometimes longer). The registered chemical control methods are highly effective on growing plants, but Bathurst Burr will survive as a seed bank for several years.

Distribution

Current Australian distribution:

Bathurst Burr is widespread in Australia, occurring in all states and the Northern Territory. It is particularly widespread in Queensland, occurring in southern, western and central areas, but is seldom important in the tropics. It prefers drier areas, such as well-drained contour banks and lighter soils.

Current South Australian distribution:

The distribution of Bathurst Burr is disjunct due to its habitat requirements, but extends from eastern Eyre Peninsula through the North East Pastoral, mid North, Yorke Peninsula, Riverland, South East and parts of the mallee.

Current District distribution:

There are no known infestations of Bathurst Burr in the Kingoonya District.

Potential distribution:

Potential distribution of Bathurst Burr extends across the agricultural zone from western Eyre Peninsula to the South East, and also in suitable microhabitats in the Alinytjara Wilurara and SA Arid Lands regions. The main sites open to infestation are around dams, along drains and the flood-out areas associated with creeks and rivers.

Policy

National Strategy:

Bathurst Burr is not classified as a Weed of National Significance, therefore there is no National Strategy for this species.

State Policy:

To minimise losses to the wool industry due to hardhead burr contamination.

Under the Natural Resources Management Act, 2004:

- Prohibiting movement of Bathurst Burr on public roads.
- Prohibiting sale of Bathurst Burr.
- Prohibiting sale of goods contaminated with Bathurst Burr.
- Landowners to control Bathurst Burr on their properties.
- Landowners to comply with regulations or instructions.
- Allowing NRM authorities to recover costs from landholders for control of Bathurst Burr on adjoining road reserves.

SA Arid Lands NRM Policy:	SAAL NRM regional management strategy for Bathurst Burr is to MANAGE sites. Aim: To reduce the overall economic and/or social impacts of this weed through targeted management.
Kingoonya NRM District management strategy	Kingoonya NRM District management strategy for Bathurst Burr is ALERT Aim: Entry into the region should be prevented – any Bathurst Burr found should be reported and destroyed.

Kingoonya NRM District Strategy for management of Bathurst Burr

Recommended Actions
Support land manager education in identification, monitoring and control of Bathurst Burr.
Identify current distributions of Bathurst Burr in neighbouring NRM regions/districts and ascertain possible pathways of entry into Kingoonya NRM District.
Infestations of all Bathurst Burr in the Kingoonya NRM District to be surveyed, mapped and reported to NR SAAL immediately. Destruction of all infestations as they are identified, aiming for local eradication.
Land managers are encouraged to monitor success, following control of Bathurst Burr, and carry out follow up control as necessary.
Sale and movement of Bathurst Burr to be prevented within Kingoonya NRM District.
Must not grow.

Best Practice Control

Control method and description	**Best time to control**	**Active ingredients and example trade names**	**Herbicide rates and carrier**
Foliar Spray			
Spot spraying with a knap sack or quad/ute mounted spray unit can be used Spray the entire plant with the recommended herbicide mix.	Before flower and burr formation	Glyphosate (450g/L) e.g. Roundup®	1L/100L water + Surfactant e.g. Pulse®
Spot spraying with a knap sack or quad/ute mounted spray unit can be used Spray the entire plant with the recommended herbicide mix Soil active herbicide, may damage desirable vegetation.	Before flower and burr formation	Glyphosate (450g/L) + metsulfuron-methyl (600g/L) e.g. Roundup® +Ally®	1L + 7g/100L water + Surfactant e.g. Pulse®
Hormone type treatment – use with caution near sensitive crops. Refer to drift warnings on label. Grass pastures – Spray seedlings, use higher rates on larger plants or plants in late flower.	Before flower and burr formation	MCPA (340g/L) + dicamba (80g/L) e.g. Banvil®M	190-270ml/100L water
Physical			
Ground can be cultivated in suitable areas during seedling stage.			

Surveys/ Monitoring

General method:	Keep an eye out for Bathurst Burr during routine pastoral management activities, especially along drainage lines, and record locations using a GPS or farm map.
Best time of year for surveys:	Late spring through to late autumn, especially after summer rains.

Noogoora Burr

Common name(s): Noogoora Burr

Scientific name: Xanthium strumarium sp. agg.

Plant description: A single or multi stemmed herb growing up to 2m high. Its stems are hairy but without spines.

The leaves are broad-ovate to triangular, 50-150mm wide, 3 or 5 lobed, with a lobed base and toothed margins. The upper leaf surface is darker green than the under surface and prominently 3-veined with purplish veins. The leaf stalk (petiole) is 20-120 mm long (modified from Cross et al., unpublished).

The flowers are unisexual with separate male and female flowers on the same plant. The cream or creamy green male flowers are clustered at the end of the branches, or in the upper leaf axils while the yellowish green to brown female flower heads occur in the leaf junctions.

The burrs are ellipsoid, 15-25 mm long, with glandular & non-glandular hairs, covered with numerous hooked spines and with 2 longer stout and straight spines (or 'beaks'). Two seeds formed in each burr, one larger than the other (modified from Cross et al., unpublished).

Photo 42: Noogoora Burr with seed pods (Photo depi.vic.gov.au)

Photo 43: Dry Noogoora Burrs' on plant (Photo lrm.nt.gov.au)

Flowering: Seeds may germinate in response to late spring/summer rain. Flowering occurs from mid-summer to autumn with burrs forming from February to May.

Origin: North America

When introduced: 1860's into Australia. Recorded in South Australia in 1916 and eradicated, but reinfested in 1959 when large numbers or sheep were imported that had Noogoora Burr in their wool.

Why introduced: Probably introduced to Australia at Noogoora station, in Queensland, in the 1860's as a contaminant of cotton seed.

Other information: Noogoora Burr, Xanthium strumarium is a group of species including X. occidentale (Noogoora Burr) and X. californicum (Californian burr). Both weeds are annual plants that have been introduced from North America. They are very similar in appearance and ecology and can be described together.

Threats and Impacts

Invasiveness

Large dense infestations are dependent on periodic wet summers. The seed must be in good contact with water to germinate. Low temperatures are lethal to Noogoora Burr.

Noogoora Burr is dispersed by burrs attached to stock, and also along watercourses by floodwaters. To establish it requires a year with summer rains to provide adequate water to break seed dormancy.

Impacts

The major concern with Noogoora Burr is as a contaminant of wool. The burrs contribute to hardheads, which damage shearing machinery. Spines of this plant also cause physical damage to stock and people. Wool processors generally reject infested wool.

Although Noogoora Burr seedlings are poisonous, the main toxin (carboxyatratyloside) is found only in the cotyledons. Cases of stock poisoning are very rare in Australia.

Noogoora Burr competes strongly with pastures due to its extensive root system and rapid growth.

Persistence

In SA, most infestations of the Noogoora Burr group have been eradicated easily. This is probably due to unsuitable environments or by controlling the few plants surviving after many dry years.

There are few areas of SA suitable for Noogoora Burrs to persist. In the pastoral lands, these areas are often the most productive, as they are the accumulation areas for runoff.

There are 2 seed in each burr and the upper one germinates in the following season while the lower one remains dormant for 2 or more years. It has several types of dormancy (enforced, innate and induced) making control difficult.

Distribution

Current Australian distribution:

Noogoora Burr is widespread throughout most parts of New South Wales and Queensland, extending across into the Northern Territory, particularly around the Katherine, Daly Waters and Darwin regions and also the river systems flowing into the Gulf of Carpentaria. A few collections have been recorded from around the Alice Springs region. It also has a scattered distribution through northern Victoria and eastern South Australia, particularly around the Murray River and some tributaries. A few infestations have been recorded from the Kimberley region and the Perth region of Western Australia. One infestation was recorded in Tasmania but has since been eradicated (Parsons & Cuthbertson 1992; AVH 2007).

Current South Australian distribution:

Two species of the Xanthium strumarium complex are known to occur in SA.

The Californian burr (Xanthium californicum) is distributed along the River Murray from the Victorian border to Swan Reach, with occasional plants and small patches downstream from Swan Reach. It is also established on the Gawler River.

The true Noogoora Burr (Xanthium occidentale) is also found with Californian burr adjacent to the River Murray from Lyrup ferry upstream to the Victorian/NSW border. Other areas include 5500 ha at Kallioota Swamp on Lake Torrens, small isolated infestations along the Coopers Creek system, and in the Mingary-Cockburn area.

Occasional plants are found throughout the state, especially adjacent to dams, waterholes, saleyards, transport depots and stock holding areas.

Current District distribution:

There are no known populations of Noogoora Burr in the Kingoonya District.

Potential distribution

In South Australia, suitable habitats are restricted to wetlands adjacent rivers, some flood irrigation areas, drains, creeks and flood outs, which may be inundated during summer.

Policy

National Strategy: Noogoora Burr is not classified as a Weed of National Significance, therefore there is no national strategy for this species.

State Policy: For Grazing Rangelands the State Policy is to Monitor.

Under the *Natural Resources Management Act*, 2004:

- Prohibiting entry to area of Noogoora Burr.
- Prohibiting movement of Noogoora Burr on public roads.
- Prohibiting sale of Noogoora Burr, or produce or goods carrying Noogoora Burr.
- Requiring notification of Noogoora Burr infestations to NRM authorities.
- Requiring landholders to control Noogoora Burr on their properties.
- Allowing recovery of control costs on adjoining road reserves of Noogoora Burr.

SA Arid Lands NRM Policy: SAAL NRM regional management strategy for Noogoora Burr is to MONITOR for any changes in the species weed risk.

Aim: To detect any significant changes in Noogoora Burr's weed risk and monitor the spread of the species and review any changes in weediness.

Kingoonya NRM District management strategy Kingoonya NRM District management strategy for Noogoora Burr is ALERT

Aim: Entry into the region should be prevented – any Noogoora Burr found through monitoring should be reported and destroyed.

Kingoonya NRM District Strategy for management of Noogoora Burr

Recommended Actions

Support land manager education in identification, monitoring and control of Noogoora Burr.

Occurrences of Noogoora Burr in Kingoonya NRM District to be surveyed, mapped and reported to NR SAAL immediately.

Identify current distributions of Noogoora Burr in neighbouring NRM regions/districts and ascertain possible pathways of entry in to Kingoonya NRM District.

Destruction of all infestations, as they are detected, aiming for local eradication.

Land managers are encouraged to monitor success, following control of Noogoora Burr, and carry out follow up control as necessary.

Sale and movement of Noogoora Burr to be prevented within Kingoonya NRM District.

Best Practice Control

Control method and description	Best time to control	Active ingredients and example trade names	Herbicide rates and carrier
Foliar spray			
Spot spray - Hormone type treatment – use with caution near sensitive crops. Refer to drift warnings on label. Spray seedlings only.	When actively growing and before flower and burr formation.	2,4-D amine (625g/L) e.g. 2,4-D Amine 625	17-22ml/10L water + Surfactant e.g. Pulse®
Spot spray – **Do not add surfactants** if using near aquatic areas. Suitable for use near waterways – refer to label. Non-selective, avoid contact with desirable plants.	When actively growing and before flower and burr formation.	Glyphosate bioactive (360g/kg) e.g. Roundup Biactive®	1L/100L water
Boom spray - Non-selective, avoid contact with desirable plants. Fallow or prior to planting a crop or pasture.	When actively growing and before flower	Glyphosate (450g/L) e.g. Roundup®	1.5-2.5L/ha + Surfactant e.g. Pulse®

	and burr formation.		
Spot spray - Non-selective, avoid contact with desirable plants. Soil active herbicide, may damage desirable vegetation.	When actively growing and before flower and burr formation.	Glyphosate (450g/L) + metsulfuron-methyl (600g/L) e.g. Roundup® + Ally	1L + 7g/100L water + Surfactant e.g. Pulse®
Spot spray - Hormone type treatment – use with caution near sensitive crops. Refer to drift warnings on label. Grass pastures. Use higher rate on late flowering or larger plants.	When actively growing and before flower and burr formation.	MCPA (340g/L) + dicamba (80g/L) e.g. Banvil®M	190-270ml/100L water

Physical

Seedlings and individual plants can often be pulled up by hand (In large infestations this may not be practical).

Manual hoeing or slashing should occur before burr formation.

Plants with burrs should be collected and burned.

Surveys/ Monitoring

General method: Keep an eye out for Noogoora Burr during routine pastoral management activities, especially along drainage lines, and record locations using a GPS or farm map.

Best time of year for surveys: Summer through to late autumn, especially after summer rains.

Bibliography

Agnew, D (2009), A local action plan for African Rue. South Australian Arid Lands NRM Board.

Agriculture & Resource Management Council of Australia & New Zealand, Australian & New Zealand Environment & Conservation Council and Forestry Ministers, (2000) *Weeds of National Significance Mesquite (*Prosopis *species) Strategic Plan.* National Weeds Strategy Executive Committee, Launceston.

Agriculture & Resource Management Council of Australia & New Zealand, Australian & New Zealand Environment & Conservation Council and Forestry Ministers, (2000) *Weeds of National Significance Parkinsonia (*Parkinsonia aculeata*) Strategic Plan.* National Weeds Strategy Executive Committee, Launceston.

Agriculture & Resource Management Council of Australia & New Zealand, Australian & New Zealand Environment & Conservation Council and Forestry Ministers, (2000) *Weeds of National Significance Athel Pine (*Tamarix aphylla*) Strategic Plan.* National Weeds Strategy Executive Committee, Launceston.

CSIRO. (2008). The costs and benefits of Buffel Grass and its management. Retrieved 29-6-10, from http://www.csiro.au/science/BenefitCostOfBuffel.html.

Department of Environment and Natural Resources. (2010). Census of South Australian Plants, Algae and Fungi Retrieved 2010, from http://www.flora.sa.gov.au/census.shtml.

Department of the Environment, Water, Heritage and the Arts. (2009). Weeds in Australia. Retrieved 23-6-10, from http://www.weeds.gov.au/.

Department of Water, Land and Biodiversity Conservation (2007) *Declared Plant Policy, African Boxthorn*

Department of Water, Land and Biodiversity Conservation (2007) *Declared Plant Policy, Athel Pine*

Department of Water, Land and Biodiversity Conservation (2007) *Declared Plant Policy, Innocent Weed*

Department of Water, Land and Biodiversity Conservation (2007) *Declared Plant Policy, Mesquite*

Department of Water, Land and Biodiversity Conservation (2007) *Declared Plant Policy, Opuntia species*

Department of Water, Land and Biodiversity Conservation (2007) *Declared Plant Policy, Parkinsonia.*

Kingoonya Soil Conservation Board (2002). *Kingoonya Soil Conservation Board District Plan.*

Holtkamp, R. (2006). Primefact: Hudson Pear. NSW Department of Primary Industries, New South Wales.

Parsons, W.T. & Cuthbertson, E.G. 2001, *Noxious Weeds of Australia*, 2nd edn, CSIRO Publishing, Collingwood, Victoria.

Richardson, F. J., Richardson, R. G. and Shepherd, R. C. H. (2006). Weeds of the south-east: an identification guide for Australia. R.G. and F.J. Richardson, Meredith, Victoria.

The State of Queensland (2004), Parkinsonia - National Case Studies Manual (2004), Department of Natural Resources, Mines and Energy, 2004

Virtue, J.G. (2005). *SA weed risk management guide, August 2005*. Department of Water Land & Biodiversity Conservation, South Australia.