



Situation statement:

the 'Prickle Bush' Weeds
(Mesquite, Parkinsonia and Prickly acacia)
in Western Australia



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Cover: Prickly acacia west of Wyndham. Photo by Tracey Vinnicombe, DAFWA

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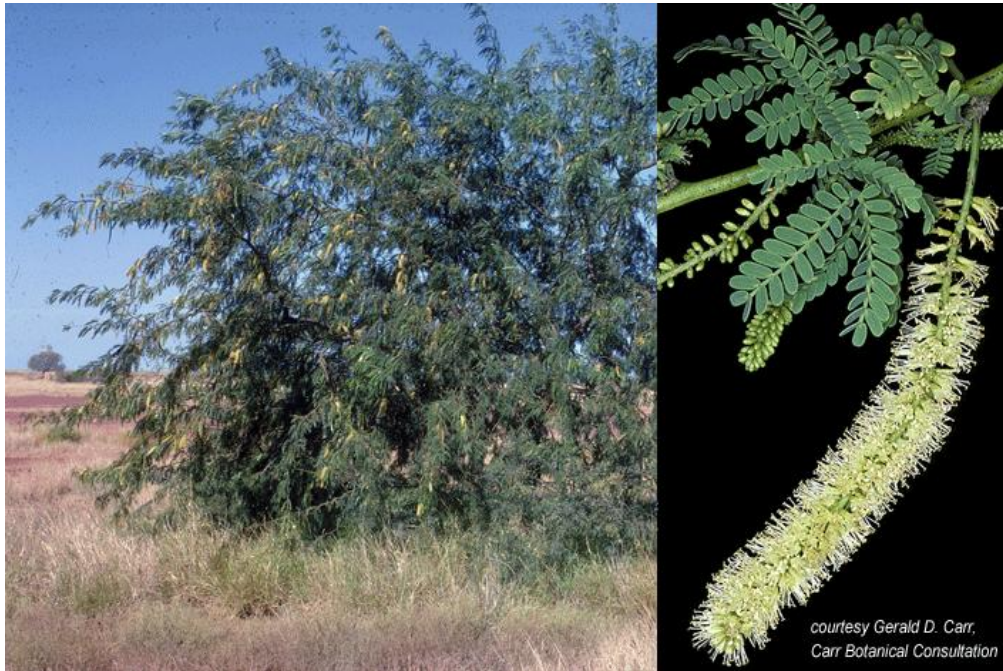
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(a) Mesquite



(b) Parkinsonia

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Figure 1: Images of the three Prickle bush weeds: (a) Mesquite – plant, foliage and inflorescence; (b) Parkinsonia – plant, foliage and inflorescence; (c) Prickly acacia (see Front Cover – Prickly acacia infestation west of Wyndham)

Situation Statement on the Prickle bush weeds (Mesquite, Parkinsonia and Prickly acacia) in Western Australia

EXECUTIVE SUMMARY

Introduction

The term 'Prickle bush weeds' refers to weedy trees and shrubs of Mesquite, Parkinsonia and Prickly acacia. All are present in Western Australia.

Mesquite and Parkinsonia are widespread, well established woody weeds in various parts of the WA Rangelands. Prickly acacia is a recent introduction and has a relatively restricted distribution in the East Kimberley. All three impact mainly on the pastoral industry and have considerable potential for further spread and greater impact within the Rangelands. All are Weeds of National Significance (WoNS) and are high priority Declared Plants in WA.

Purpose

The purpose of this situation statement is to describe the distribution, impact and current management of Mesquite, Parkinsonia and Prickly acacia in the Rangelands of WA. It also identifies the major stakeholders for these weeds.

The situation statement provides a 'snapshot' of the Prickle bush weeds and their management, and will lead to the development of state-level management and response plans for these weeds.

The report outlines the readily-available best practice management measures (developed locally and nationally as part of the WoNS program) that can be used to eradicate, contain or control current infestations of these woody weeds.

Declaration status

Mesquite, Parkinsonia and Prickly acacia are currently Declared Plants targeted for eradication in most parts of the Rangelands. The declaration status of Mesquite and Parkinsonia as eradication targets has been in place for many years; however, their declaration status is not consistent with the current national view that these weeds should be 'control targets' in WA (as defined in their WONS Strategic Plans) rather than eradication targets. The status of Prickly acacia as an eradication target in WA is appropriate, and is consistent with its WoNS Strategy.

Despite the status of Mesquite and Parkinsonia as eradication targets, control activities carried out by landholders and regulatory and compliance activities delivered by DAFWA are, at times, insufficient and ineffective.

Stakeholders

Stakeholders with interests in (and responsibility for) Mesquite, Parkinsonia and Prickly acacia include landholders associated with the pastoral industry, the Rangelands Recognised Biosecurity groups (specifically the Kimberley, Pilbara, Carnarvon, Meekatharra and Kalgoorlie RBGs), the Pilbara Mesquite Management Committee (PMMC), Rangelands NRM, local government, the Department of Environment and

Conservation (DEC) and DAFWA. Other significant stakeholders include indigenous land managers, operators of mining leases, the Pastoral Lands Board, and wildlife conservation groups. The diversity of stakeholders adds to the complexity of achieving coordinated management of these weeds. In the Pilbara, the PMMC and the Pilbara RBG are viewed as key stakeholder groups for Mesquite and Parkinsonia management.

Distribution

The occurrence of these weeds is relatively well documented in most parts of the Rangelands, especially as a result of recent aerial mapping carried out by the PMMC for Mesquite and Parkinsonia in the Pilbara and Gascoyne.

The amounts of each weed across the Rangelands are summarised below.

Rangelands sub-region *	Mesquite	Parkinsonia	Prickly acacia
Kimberley	~ 28,000 ha	Very extensive – not quantified	15-17,000 ha
Pilbara	~ 303,502 ha	800 ha and along 785 km of rivers	Absent
Carnarvon	18,334 ha	~ 2 ha	Absent
TOTAL	~ 349,836 ha, mostly in Pilbara sub-region	Too much to calculate in Kimberley sub-region. Significant amounts in Pilbara; little in Carnarvon sub-region	15-17,000 ha, confined to the East Kimberley
* Names are those of the sub-regions covered by the Rangelands Recognised Biosecurity Groups – see Fig. 5			

Management

Many of the Pilbara pastoral properties with infestations of Mesquite and Parkinsonia have formal Weed Action Plans (WAPs) for these weeds, which have been developed between the landholders, PMMC and DAFWA regional Biosecurity Officers. It is important that WAPs be developed for infestations of the Prickle bush weeds throughout the Rangelands.

Capacity

There is a critically low level of weed management capacity in the Rangelands. Strategic partnerships set up with relevant groups are required to provide the extra resources needed for greater involvement with these weeds.

Regulation and compliance

Limited compliance and enforcement of WAPs is expected to be applied to pastoral properties with Prickle bush weeds. DAFWA biosecurity officers may become involved in audit and compliance activities where there is clear investment by the community in control within a shire or region, and when an individual landholder is failing to undertake control in line with community expectations.

Surveillance, monitoring, evaluation and reporting

Properties infested with these and other priority Declared Plants require regular inspections by Biosecurity Officers, backed up by completion of Field Reporting Forms (FRFs).

When all properties infested with Mesquite, Parkinsonia and Prickly acacia have been documented, it will be possible to begin the process of identifying critical infestations to which local eradication efforts should be directed.

Specimens of the Prickle bush weeds held in the WA Herbarium provide valuable evidence of their statewide distribution; however, the coverage represented by those herbarium specimens is not complete. The documentation of the distribution of these weeds in WA would improve if herbarium specimens were collected from all infestations.

Potential distribution in WA

None of these weeds has reached its full potential distribution in WA, and their full impacts have not yet been felt. Spread modelling has been completed for Prickly acacia statewide, and for Mesquite in the West Pilbara, but this has not been done for Parkinsonia. In view of these weeds' similar ecology and impacts, spread modelling of Parkinsonia and Prickly acacia in the Rangelands might not be necessary.

The spread of Mesquite and Prickly acacia seeds consumed by livestock and native vertebrates is an important aspect of the dispersal of these weeds. Measures are needed to reduce local and long-distance seed transport, especially during the movement of cattle and other livestock in trucks.

Impacts

The qualitative impacts of the Prickle bush weeds are well documented and are similar for all three weeds. All are primarily weeds of production that affect pastoral industries, but they can also have environmental/biodiversity impacts, especially Parkinsonia in riverine habitats.

Their quantitative impacts in Australia appear not to have been measured, although a few overseas publications provide quantitative data on the impacts of Mesquite.

Quantitative or non-quantitative analyses (such as Benefit Cost Analyses) of the impacts of these weeds in WA would emphasise their importance to the Rangelands.

1. INTRODUCTION

1.1 Purpose and scope

The purpose of this situation report is to describe the distribution, impact and current management of Mesquite (*Prosopis* spp. and hybrids), Parkinsonia (*Parkinsonia aculeata*) and Prickly acacia¹ (*Acacia nilotica* ssp. *indica*) in the Rangelands of WA. It also identifies the major stakeholders for these weeds, which include landholders associated with the pastoral industry, the Rangelands Recognised Biosecurity groups (specifically the Kimberley, Pilbara, Carnarvon, Meekatharra and Kalgoorlie RBGs), Rangelands NRM, the Pilbara Mesquite Management Committee (PMMC), local government, the Department of Environment and Conservation (DEC) and DAFWA.

The report also outlines the readily-available best practice management measures developed locally and nationally (as part of the WoNS program) that can be used to eradicate, contain or control current infestations of these woody weeds.

1.2 Links to the Department of Agriculture and Food's Invasive Species Strategy

Mesquite, Parkinsonia and Prickly acacia are recognised as priority weeds in DAFWA's "Invasive Species Strategy (2012-2017)" (Invasive Species Program 2012) due to their categorisation as declared plants targeted for eradication in parts of this state, and their status as Weeds of National Significance (WoNS).

They will be referred to as the 'Prickle bush weeds' in many parts of the following report: this is the term applied to these three weeds when they received joint national coordination as part of the WoNS program (Anon 2010).

1.3 Ecological information

Mesquite, Parkinsonia and Prickly acacia are fast-growing, thorny or spiny leguminous shrubs or trees that can rapidly form impenetrable thickets in tropical and sub-tropical regions.

Mesquite and Parkinsonia are native to central and South America, while the form of Prickly acacia naturalised in Australia originated from India and Pakistan. Mesquite and Parkinsonia were probably introduced from parts of the world where they were already being cultivated for shade, fodder production (for their nutritious pods and foliage) and as ornamental trees (van Klinken and Campbell 2009), while Prickly acacia was first introduced to Australia (Queensland) in the 1890s from Pakistan and India for use as shade and ornamental trees and for their protein-rich pods which provided stock feed (Mackey 1998).

1.3.1 Mesquite

Biology and ecology

Mesquite (*Prosopis* spp.: Family Fabaceae [previously Mimosaceae])

- a highly invasive shrub or tree commonly 3-10 m in height (Fig. 1)
- capable of forming dense, thorny thickets

¹ In WA the name Prickly acacia is often applied to Mimosa bush, *Vachellia farnesiana* (previously *Acacia farnesiana*), which is widespread throughout the Rangelands; however, throughout this report the name Prickly acacia refers only to *Acacia nilotica* – see Section 1.3.3 below.

- several species and one hybrid currently infest nearly 1 million hectares of semi-arid parts of tropical and sub-tropical Australia
- the Mardie infestation in the Pilbara is Australia's largest, occupying over 150,000 ha, of which 30,000 ha is high density
- once established, Mesquite trees are long-lived and produce large numbers of large pods containing flat seeds embedded in sweet fibrous pulp
- seeds are long lived (>10 years).

Dispersal of Mesquite occurs in two main ways:

- most spread is by movement of seeds by livestock and native herbivores (eg. cattle, sheep, horses, feral pigs, kangaroos, emus) that readily consume the pods
- the pods themselves are spread along water courses and by flood waters.

Livestock and native vertebrates can spread mesquite relatively large distances within a station, while flood waters, human-mediated transport of livestock, and unmanaged travel of feral livestock and native animals all result in long-distance dispersal.

Best Management Practice

As with many rangeland weeds, the high cost of control options for Mesquite and the other Prickle bush weeds can greatly exceed the value of the land and its productive capacity; however, their potential to infest much larger areas justifies intervention to eradicate or contain current infestations.

The Mesquite Best Practice Management Guide (Anon 2003) lists a large number of control methods available for Mesquite, although not all those techniques are recommended for implementation against Mesquite in the Pilbara, for example chain pulling and dozer-pushing.

The choice of method(s) depends on the form of the Mesquite plants being controlled (tree- or shrub-form), stand density and plant age (seedlings or mature plants). Integration of methods is generally necessary because rarely will any one control option fix the problem. Some methods that are known to be suitable for use on most Mesquite infestations have been found to be less effective against the hybrid Mesquite found at Mardie, due possibly to the hybrid's greater vigour and resilience.

The PMMC has recently published a guide describing suitable Mesquite control techniques for the Pilbara (Anderson 2011). Recommended treatments include:

- Physical control
 - Blade ploughing
 - Stick raking
 - Fire
- Chemical control
 - Basal bark spraying
 - Cut stump treatment
- Biological control
 - Seed feeding bruchid beetles
 - Leaf tying moth²

² A third biological control agent, the sap sucking psyllid, has not been released in WA (L. Anderson, pers. comm.).

Research by the PMMC and the CSIRO from 2002-2007 found that chaining and the use of bulldozers (without cutter bars or similar attachments) were relatively ineffectual in the Pilbara, where hybrid mesquite (*Prosopis glandulosa* x *velutina* Torr. & Wooton) is the dominant form present.

Although this technique is not recommended for the Pilbara sub-region, mechanical removal of adult Mesquite trees by bulldozers, followed by herbicidal control of seedlings and juvenile plants, has been proposed for eradicating the Mesquite infestation on a station in the East Kimberley, which is the State's only confirmed population of *Prosopis glandulosa* Torr.. The different response to bulldozing is probably due to differences in regenerative capacity between the hybrid Mesquite and *P. glandulosa*.

Granular herbicides are applied aerially in the West Kimberley to control populations of Mesquite that largely infest floodplain areas, where difficult terrain restricts access by vehicles, other vegetation is relatively sparse and predictable rainfall provides opportunities for strategic use of this technique.

Foliar spraying is not used in the Pilbara, because it requires specialised equipment and it also interferes with the beneficial biological control activities of the leaf tying moth.

1.3.2 Parkinsonia

Biology and ecology

Parkinsonia (*Parkinsonia aculeata*: Family Fabaceae [previously Caesalpiniaceae])

- a highly invasive spiny shrub or small tree commonly 2-8 m in height, with many slender green branches (Fig. 1)
- produces 5-petalled yellow flowers (one petal with an orange spot), and smooth slender pods up to 10 cm long
- capable of forming dense, often impenetrable thorny thickets, especially on flood-prone land (floodplains, water courses and drains)
- currently infests almost 1 million hectares of Australia's semi-arid tropics and sub-tropical regions
- dense infestations make land inaccessible for people and animals, restrict livestock access to water sources, decrease pasture yield, make mustering operations nearly impossible, exclude native vegetation, and harbour pest animals.

Dispersal is mainly by water:

- the buoyant pods and seeds are readily spread along water courses and by flood waters
- the pods are relatively unpalatable to livestock; however, they are readily consumed by feral camels
- some birds and other animals eat the pods and disperse the seeds in their gut
- some seeds are moved long distances in mud sticking to animals, machinery and footwear.

Best Management Practice

A wide range of control methods is available for Parkinsonia. These are largely the same as for Mesquite – see above. The control options are well documented in the Parkinsonia National Case Studies Manual (Anon 2004a).

There are some notable recent developments with biological control of Parkinsonia that could be of great relevance to managing this weed in WA. A project on the release and evaluation of the Parkinsonia looper in WA has been funded by WA's Cattle Industry Funding Scheme Management Committee (in mid-2012).

In Western Queensland, trials of soil-borne fungi that cause dieback in *Parkinsonia* are showing great promise by causing high levels of mortality in *Parkinsonia*.

1.3.3 Prickly acacia

Biology and ecology

Prickly acacia (*Acacia nilotica* ssp. *indica*: Family Fabaceae [previously Mimosaceae]) shares many characteristics with Mesquite, as follows:

- a thorny shrub or tree growing to 5 – 10 m in height (see front cover)
- capable of forming dense thorny infestations that invade and dominate tropical grasslands and grass-based pastures
- produces large numbers of distinctive flat, grey-green pods up to 25 cm long, each containing 8-15 hard-coated seeds and deeply constricted between each seed
- seeds are hard coated and relatively long lived (~7 years).

Dispersal of Prickly acacia is due to the movement of seeds, especially as a result of ingestion of its palatable pods by cattle. Floodwaters and mud can also spread the seeds and pods long distances.

Best Management Practice

As with the other Prickle bush weeds, a wide range of control methods is available for Prickly acacia, as documented in the Prickly Acacia National Case Studies Manual (Anon 2004b).

Graslan™ applied aerially just before the wet season is being used successfully by Ord Land and Water and DAFWA to treat Prickly acacia near Wyndham.

1.4 Declaration status

1.4.1 Mesquite

All Mesquite taxa (*Prosopis* species and hybrids) are declared under the *Agriculture and Related Resources Protection Act 1976* (ARRPA). All Mesquite species and their hybrids are prohibited from entering this State.

Mesquite is currently a P1, P2 Declared Plant (eradication target) throughout the State, except at Mardie near Karratha where the infestation is in the P1, P4 category (containment – spread of the plant beyond where it currently occurs is to be prevented).

The total infestation of Mesquite at Mardie is recognised as being beyond eradication and is managed for containment; however, there is a buffer zone of 1 km around the boundary of the pastoral lease and this is managed to remain free of Mesquite, which is declared P1, P2 (eradication) in the buffer zone.

The current declaration statement for Mesquite (gazetted in January 2011) is as follows:

Mesquite (*Prosopis glandulosa* x *velutina*); all other *Prosopis* species and hybrids;

P1; for the whole of the State.

P2; for the whole of the State, except for the area on Mardie Station bordered by the coast, the boundary between Mardie and Karratha stations, the North West Coastal Highway, Peter's Creek and the boundary between Yarraloola and Mardie stations.

P4; for the area on Mardie Station bordered by the coast, the boundary between Mardie and Karratha stations, the North West Coastal Highway, Peter's Creek and the boundary between Yarraloola and Mardie stations.

The ARRPA declarations will transition to equivalent categories under the *Biosecurity and Agriculture Management Act 2007* (BAMA). Mesquite taxa already present in WA that are declared P1, P2 under ARRPA will become C2 (eradication) declared pests under BAMA, while those declared P1, P4 will become C3 (management) declared pests. All Mesquite taxa not present in WA will be Prohibited species.

1.4.2 Parkinsonia

Parkinsonia is declared under ARRPA throughout the Rangelands. It is not declared in the state's southwest, where it is not considered a threat.

In most parts of the Rangelands Parkinsonia is a P1, P2 eradication target; however, in the Kimberley sub-region, it is a P1, P4 declared plant targeted for containment.

Under BAMA, the declaration status for Parkinsonia will transition to C2 (eradication) for all parts of the Rangelands except in the Kimberley sub-region where it will be a C3 (management) declared pest.

1.4.3 Prickly acacia

Under ARRPA Prickly acacia is a P1, P2 Declared Plant (eradication target) for the entire state. It will be a C2 (eradication) declared pest under BAMA.

1.5 Status of Mesquite, Parkinsonia and Prickly acacia as Weeds of National Significance

All three Prickle bush weeds are Weeds of National Significance (WoNS). The national management actions for each of these weeds are shown on the attached maps (from Anon 2010).

Fig. 2 = Mesquite (WoNS) Management Action Map, at end of document

Fig. 3 = Parkinsonia (WoNS) Management Action Map, at end of document

Fig. 4 = Prickly acacia (WoNS) Management Action Map, at end of document

It is worth noting that the WoNS national management action maps (Figs 2, 3 and 4, and in Anon 2010) illustrate the management objectives for individual grid squares, each covering 2,500 km² (250,000 ha). At this scale the maps do not allow depiction of different types of action, including eradication, within localised infestations. Also, under WoNS planning principles, eradication targets were restricted to infestations that could be eradicated within 3 years without any increase in investment or resources. As a consequence, local infestations in WA that are suitable for eradication are not shown in these management maps.

1.5.1 Mesquite

The National Management Action map for Mesquite does not identify any Mesquite infestations within Australia as eradication targets: instead, most infestations are described as control or surveillance targets. All Western Australian infestations of Mesquite are described as "control targets", except for the area between Karratha and Onslow (including the Mardie infestation) which is designated as "Core infestation: Asset Protection. Contain/Reduce Impacts" (Fig. 2).

The WoNS management objectives/recommendations for mesquite in WA differ from the current ARRPA declarations, as follows (Table 1):

Table 1: Comparison of ARRPA Declarations and WoNS Management Actions for Mesquite in WA.

Area	ARRPA	WoNS Management Action *	Comment
Whole of state except West Pilbara between Karratha and Onslow	Eradication (P1, P2) except in core part of Mardie Station where Containment (P1, P4)	Control target , except between Karratha and Onslow	Eradication (P1, P2) status is not reflected anywhere in the WoNS Management Action Map.
West Pilbara between Karratha and Onslow	Eradication (P1, P2) except in core part of Mardie Station where Containment (P1, P4)	Asset Protection with impacts contained or reduced , between Karratha and Onslow.	The concept of Core infestation with asset protection is applied to an area much larger than Mardie Station in the WoNS Management Action Map.
* The WoNS National Management Action maps are based on 2,500 km ² (250,000 ha) grid squares and do not allow for different action classes within local infestations. Within the National Management Actions, eradication targets are defined as those that could be eradicated within 3 years with no increase in investment or resources.			

1.5.2 Parkinsonia

The ARRPA declaration and the WoNS National Management Actions for Parkinsonia in the Kimberley sub-region are largely equivalent; however, the objectives differ in the Pilbara, where the ARRPA category is Eradication, but the WoNS Management Action is Control (Fig. 3; Table 2).

Table 2: Comparison of ARRPA Declarations and WoNS Management Actions for Parkinsonia in WA.

Area	ARRPA	WoNS Management Action *	Comment
East and West Kimberley	Containment (P1, P4)	Core Infestation: Asset protection. Contain/Reduce Impacts	ARRPA declaration and WoNS Management Actions are largely equivalent.
Pilbara	Eradication (P1, P2)	Control target	Eradication (P1, P2) status is not reflected in the WoNS Management Action Map for the Pilbara.
* The WoNS National Management Action maps are based on 2,500 km ² (250,000 ha) grid squares and do not allow for different action classes within local infestations. Within the National Management Actions, eradication targets are defined as those that could be eradicated within 3 years with no increase in investment or resources.			

The divergence of management objectives between the ARPPA/BAMA declarations and WoNS Management Actions suggests that the current declaration categories for Mesquite and Parkinsonia should be reviewed.

1.5.3 Prickly acacia

The National Management Map for Prickly acacia identifies all infestations of this weed in WA as eradication targets, with an eradication deadline of 2015 (Fig. 4).

This WoNS management objective is consistent with the current ARPPA and proposed BAMA declaration categories, although increased resources and greater coordination of control effort will be required if the eradication deadline is to be met.

1.6 Stakeholders and current management

The principal stakeholder groups for the Prickle bush weeds are

- Rangelands NRM
- the Pilbara Mesquite Management Committee and
- the Rangelands RBGs.

A significant number of other stakeholders are currently involved with the actual management of Prickle bush weeds, including:

- landholders and pastoralists
- DAFWA
- Ord Land and Water
- mining companies, through both mining leases and pastoral stations now owned by mining companies
- indigenous land managers
- CSIRO, regarding research opportunities for biological control
- Local Government
- Pastoral Lands Board
- Department of Environment and Conservation, in relation to infestations on conservation reserves and Unallocated Crown Land
- Department of Water, in relation to management of weeds on water reserves
- Department of Regional Development and Lands, in relation to infestations on Unallocated Crown Land and Unmanaged Reserves
- Main Roads WA (MRWA), in relation to infestations on roadsides managed by MRWA.

This large number and diversity of stakeholders adds to the complexity of achieving coordinated, consistent management of Mesquite, Parkinsonia and Prickly acacia in WA.

1.6.1 Rangelands NRM

The Rangelands NRM region is the largest of the NRM regions in Australia. It covers around 85% (2,266,000 sq km) of WA's land mass, and 75% of the state's coastline. Due to the vast size of the Rangelands in WA, Rangelands WA undertakes community engagement through four sub-regions.

Rangelands NRM is a non-government organisation responsible for the establishment, management, evaluation and communication of many natural resource management activities and projects. Through its landcare activities, it is a key stakeholder in several weed management activities in the rangelands (<http://www.rangelandswa.com.au>).

Most of Rangelands NRM's current projects are funded by grants from the *Caring for Our Country* program. It is a major source of funds for the PMMC, which has delivered

several highly successful projects on Mesquite and Parkinsonia, some of which are shown in Table 3.

Table 3: Recent Rangelands NRM projects on Mesquite and Parkinsonia, delivered through the Pilbara Mesquite Management Committee (PMMC)

Date	Project name	RBG sub-region	Total project investment
July 2004 - June 2007	Developing and implementing Best Management for fire tolerant <i>Mesquite</i> (33086)	Pilbara	\$545,707
Dec. 2007 – Dec. 2008	Managing invasive plant species – <i>Parkinsonia</i> on De Grey / Shaw River (LNHT24)(with DeGrey LCDC)	Pilbara	\$265,320
July 2007 – Dec. 2008	Management of Invasive Species – <i>Mesquite</i>	Pilbara, Kimberley, Carnarvon	\$470,358
Dec. 2009 - Dec. 2011	Strategic WoNS management in Pilbara priority wetlands and floodplains	Pilbara	\$442,327
Dec. 2011 – June 2012	Advancing effective management of WoNS in the Pilbara	Pilbara	\$500,000
		TOTAL	\$2,223,712

1.6.2 The Pilbara Mesquite Management Committee

The Pilbara Mesquite Management Committee (PMMC) is a not-for-profit organisation that has been operating in the Pilbara since 2000. The group is designed to provide a common forum to discuss all aspects of Mesquite management, including ecological research, emerging control techniques, biological control impacts, value-adding opportunities, and strategic management and control.

The PMMC has been successful in obtaining and managing over \$2.7 million in external funding grants (principally from Rangelands NRM, the Royalties for Regions program, and the State NRM office), matched with over \$8 million of in-kind support from partnering stakeholders. A full time, locally based Project Coordinator oversees the delivery of strategic management and on-ground outcomes for project sponsors, supported by a skills-based executive committee and a general membership of 35 parties representing over 15 organisations. The PMMC is funded until 30 June 2013.

PMMC's strengths in coordinating funding grants are complemented with an extensive knowledge of how to best prepare and deliver on-ground control programs, training and extension in technical and practical best-practice management, planning and undertaking surveying and mapping programs, and recording and evaluating program effectiveness. While Mesquite has always been the core business of the PMMC, the similarities with Parkinsonia management has seen PMMC extend its project basis to provide more land managers with opportunities to best manage infestations of both weeds.

The PMMC has been recognised as one of the most ambitious community driven bodies of its kind in the Australian rangelands. It provides a model system for how government, industry, community and research organisations can combine to develop long term solutions to the future management of the Prickle bush weeds throughout the WA rangelands.

As a result of the activities lead by the PMMC, the status of Mesquite and Parkinsonia is better known in the Pilbara sub-region than in other parts of the WA Rangelands.

Some recent accomplishments³ of PMMC include:

- Engaging and working actively with land managers to control Mesquite and Parkinsonia.
- Controlling Mesquite across 60,000 ha of pastoral country, and Parkinsonia along 600 km of Pilbara river systems.
- Completion of an aerial survey of all known and historical populations of Mesquite across the Pilbara region.

1.6.3 Recognised Biosecurity Groups (RBGs) in the Rangelands

The five Recognised Biosecurity Groups (RBGs) began operating in the WA Rangelands in July 2010. Between them they cover the entire rangelands region, which is divided into the following sub-regions (Fig. 5):

- Kimberley sub-region
- Pilbara sub-region
- Carnarvon sub-region
- Meekatharra sub-region
- Kalgoorlie (=Goldfields Nullarbor) sub-region.

The objectives of the Pilbara Regional Biosecurity Group⁴ listed below are representative of those of all pastoral RBGs:

- initiate, promote and foster the control of declared pests in the sub-region,
- encourage landholders and other persons to adopt sound biosecurity practices throughout the sub-region,
- foster the sustainable development of the sub-region, and
- encourage the control of pests other than those declared in the sub-region.

³ Source: <http://www.ourcommunity.com.au/directories/listing?id=55120>, accessed 19 Oct. 2012

⁴ Source: Pilbara Regional Biosecurity Group Inc. Constitution (2008)

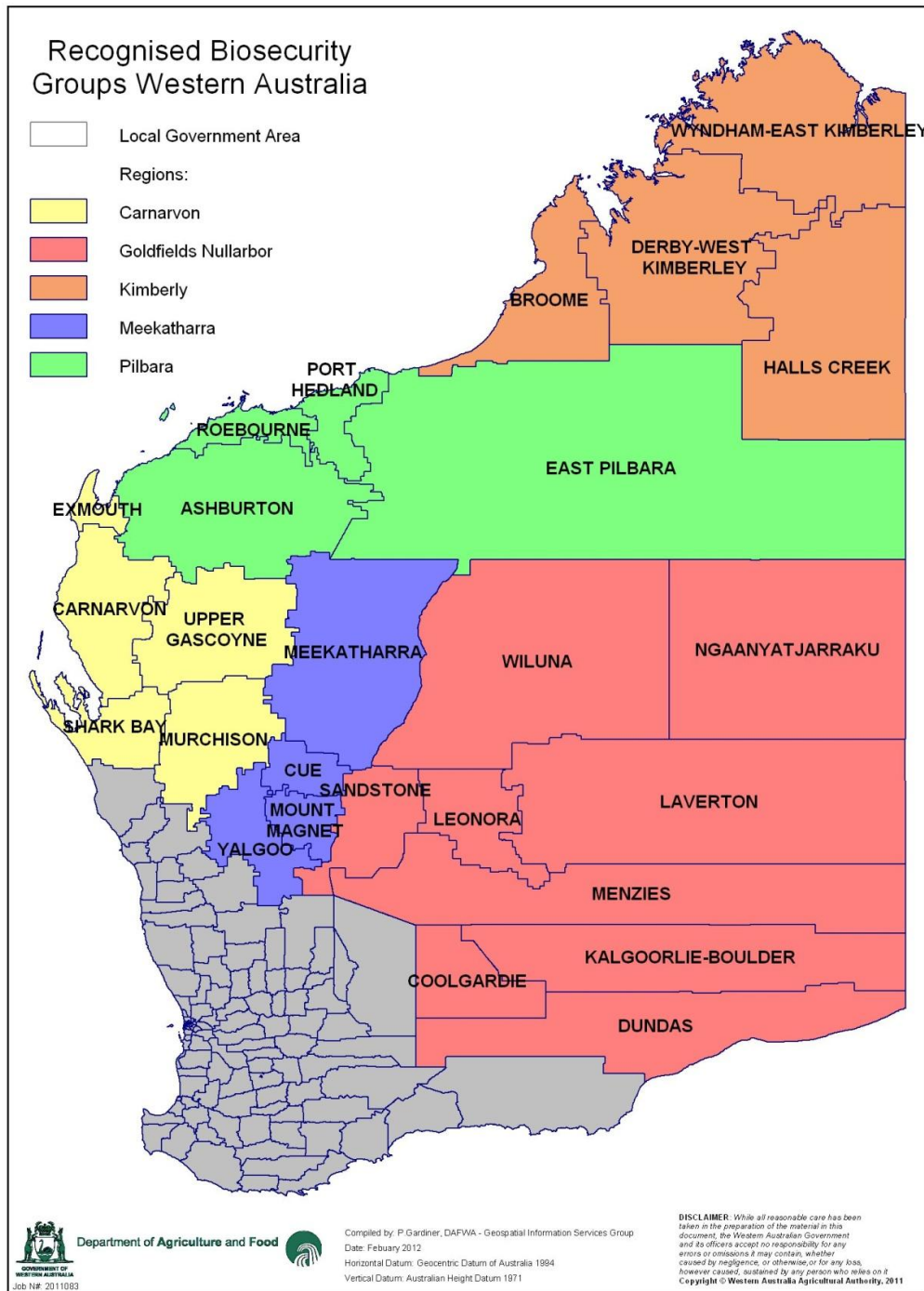


Fig. 5: Map of the sub-regions covered by the Rangelands Recognised Biosecurity Groups (RBGs) Source: Biosecurity in WA Website, accessed 1 June 2012
<http://www.biosecurity.wa.gov.au/LinkClick.aspx?fileticket=HT4R93aPiug%3d&tabid=152>

Infestations of all three Prickle bush weeds are present in the Kimberly sub-region (Table 4). Mesquite and Parkinsonia are present in the Pilbara and Carnarvon sub-regions, while Prickly acacia is known only from the Kimberly. A few small infestations or scattered individual plants of Mesquite and Parkinsonia are known outside the main distributions indicated in Table 4.

Table 4: the main distribution of the Prickle bush weeds in the Rangelands sub-regions, based on distribution maps for herbarium specimens (FloraBase, September 2012)

Weed	Kimberley	Pilbara	Carnarvon	Meekatharra	Kalgoorlie
Mesquite	✓	✓	✓	-	-
Parkinsonia	✓	✓	✓	-	-
Prickly acacia	✓	-	-	-	-

1.6.4 DAFWA's current management of the Prickle bush weeds

There are no formal, statewide policies or management plans that describe DAFWA's involvement with any of the Prickle bush weeds. DAFWA's current approach to managing Mesquite is based largely on an internal Briefing Note that provided information on the department's approach to the management of Mesquite in WA (Collopy 2004).

Historically, DAFWA's role has focused on the delivery of regulatory and compliance services. DAFWA officers also cooperate with individuals, groups and agencies (especially the PMMC) that are engaged in externally-funded control programs and other activities for these weeds. Given DAFWA's limited capacity to deliver regulation and compliance throughout the Rangelands, one of DAFWA's future roles will be to foster management of the Prickle bush weeds through partnership arrangements.

Within the Pilbara sub-region, formal Weed Action Plans (WAPs) have been developed for most of the stations with Mesquite and Parkinsonia (Table 5). In the Pilbara WAPs exist for 6 of the 9 stations with Mesquite infestations, and 6 of the 17 Parkinsonia-infested stations (with two more WAPs in progress). WAPs are in place for most of the eight Pilbara properties with both weeds present (Table 5).

The WAP template was developed by the PMMC, and is completed between the PMMC, DAFWA and the land manager with five year targets. The high level of adoption of WAPs in the Pilbara illustrates their usefulness.

Management plans devised for properties with large infestations of Parkinsonia are likely to acknowledge that active control of most of the infestation is impractical except for localised areas, e.g. for asset protection.

DAFWA's current approach to the management of the Prickle bush weeds in the Kimberley and Pilbara sub-regions can be summarised as follows:

Mesquite: in the Kimberley, pastoralists are encouraged to pursue eradication, under Weed Action Plans (WAPs). Landholders can claim subsidies for herbicides from the Kimberley RBG.

In the Pilbara, landholders treat Mesquite with the aim of controlling most infestations; however, eradication is pursued at suitable infestations.

Table 5: Mesquite and Parkinsonia infestations in the Pilbara: April 2012

Catchment/ River	Location of infestation	Aerial Survey	Date Surveyed	Last Ground Survey	Area (ha) or km of river	Weed Action Plan
Mesquite						
Fortescue	Station	Yes	2005 & 2010	2010	150,000 ha	Yes
Robe	Station	Yes	2010	2010	20,000 ha	Yes
Cane	Station	Yes	2010	2010	18,000 ha	Yes
Ashburton	Station	Yes	2010	2010	40,000 ha	Yes
Ashburton	Station	Yes	2010	2011	35,000 ha	Yes
Ashburton	Station	No			Unknown	No
Maitland	Station	Yes	2010		7,000 ha	No
Harding	Station	Yes	2010	2009	1 ha	Yes
DeGrey	Station	No		2011	At least 1,000 ha	
Ashburton	Salt production plant	Yes	2010		27,000 ha	No
Ashburton	Unallocated Crown Land - Onslow Common	Yes	2010		1,000 ha	No
Harding	Shire Reserve	Yes	2010	2009	At least 1,000 ha	No
-	Unallocated Crown Land	Yes	2010	2010	2 plants	No
					Total: at least 300,000 ha	
Parkinsonia						
Nullagine/Oakover/DeGrey	Station	Yes	2010	2009	130 km	No
De Grey	Station	Yes	2010		50 km	No
De Grey/Shaw	Station	Yes	2010		140 km	No
Shaw	Station	Yes	2010		140 km	No
Pardoo Creek	Station	No			400 ha	No
Beebingarra Creek	Station	Yes	2010		400 ha	No
Munda Creek	Station	Yes	2010	2009	7 km	No
Harding	Station	Yes	2010	2009	8 km	Yes
Maitland/ Corringer Creek	Station	Yes	2010	2010	20 km	In prep.
Fortescue	Station	Yes	2010	2011	18 km	In prep.
Fortescue	Station	Yes	2010		85 km	No
Robe	Station	Yes	2010		25 km	Yes
Robe	Station	Yes	2010	2010	28 km	Yes
Karra Creek	Station	Yes	2010	2010	7 km	Yes
Ashburton	Station	Yes	2010	2011	40 km	Yes
Ashburton	Station	Yes	2010	2010	6 km	Yes
Yannarie	Station	No			50 km	No
Harding	Shire Reserve	Yes	2010	2009	7 km	No
Fortescue	Millstream Nat. Pk	Yes	2010		20 km	
					Total ~ 800 ha & 785 km of river	

Parkinsonia: landholders generally treat Parkinsonia for containment, but with special attention paid to outliers and known infestations that might be eradicable. In the North Kimberley, Parkinsonia is targeted for eradication via WAPs, and landholders can claim herbicide subsidies from the Kimberley RBG.

In the Pilbara, Parkinsonia is treated for control, not for eradication, except where small infestations can be eradicated.

Prickly acacia: all infestations of this weed are targeted for eradication.

	Kimberley	Pilbara
Mesquite	Pursue eradication. Herbicides subsidised by Kimberley RBG.	Treat to control, not eradicate, except for small eradicable infestations.
Parkinsonia	Treat to control or contain, except in N Kimberley where targeted for eradication. Herbicides subsidised by Kimberley RBG.	Treat to control, not eradicate, except for small eradicable infestations.
Prickly acacia	Targeted for eradication, as per management plan.	(Absent)

2. MESQUITE, PARKINSONIA AND PRICKLY ACACIA IN WA – DISTRIBUTION, AND CAPACITY TO MANAGE

2.1 Distribution

2.1.1 Mesquite

Although relatively few Mesquite infestations are recorded from WA (see Fig. 2), they are widely scattered throughout the Kimberley, Pilbara and Carnarvon sub-regions of the Rangelands (Fig. 5), with infestations found from the East Kimberley to the Murchison district, where there is a small localised infestation about 350 km south east of Carnarvon⁵.

Based on information presented in the following sections and Tables 5, 6, 7 and 8, the total area infested with Mesquite in WA is approximately 350,000 ha. The greatest amount is in the Pilbara sub-region (303,502 ha), followed by the Kimberley and Carnarvon sub-regions (approx. 28,000 ha, and 18,334 ha, respectively).

Mesquite in the Kimberley sub-region

Within the Kimberley Region eight Mesquite infestations are recorded in DAFWA's IQC⁶ database for the period 2000-2012. Biosecurity Officers have confirmed infestations at six properties (Table 6).

The large (16,000 ha) infestation on a station 175 km east of Hall's Creek is significant for a number of reasons. It is the State's only known infestation of *Prosopis glandulosa* and it is located on pastoral land in the southern extremities of the Ord River Catchment. Due to its location it has considerable potential to spread downstream, infesting other stations as well as several environmentally valuable sites within the Ord River catchment⁷.

A number of aerial surveys for Mesquite have been conducted recently in the Kimberleys. These require analysis to document changes in the extent of this weed.

⁵ A single large tree of *Prosopis pallida* has recently been found cultivated in a garden in central Geraldton. It is the same tree from which herbarium specimens were collected in 1963, and is reported to be around 100 years old.

⁶ IQC = DAFWA's Inspection, Quarantine and Compliance database, which is used by Biosecurity officers to capture records of field inspections and other activities related to Invasive Species.

⁷ Ord Land and Water has recently obtained funding from the State NRM Office to control this significant infestation.

Table 6: Mesquite infestations recorded in the Kimberley

Mesquite in the Kimberley sub-region	IQC data and comments from DAFWA Biosecurity officers (2012)
Shire of Wyndham-East Kimberley	No infestations
Shire of Broome	One station: occasional plants
Shire of Derby-West Kimberley	One station: 6,000 ha with a further 6,000 ha on adjoining UCL Two stations: occasional plants
Shire of Halls Creek	One station: 16,000 ha One station: 2 ha
	Total ~ 28,000 ha

Mesquite in the Pilbara sub-region

Aerial surveys conducted by PMMC and DAFWA in 2010 recorded thirteen infestations totalling 303,502 ha in the Pilbara sub-region. Nine of these are on stations, two are on Unallocated Crown Land, one is at a salt production plant and one in a Shire reserve on the Harding River (Tables 5 & 7).

The Mardie infestation is by far the largest and densest infestation in the Pilbara and Australia, occupying over 150,000 ha. Other infestations in the Pilbara are considerably smaller than that at Mardie, but some are extensive nevertheless, and include several low to moderately dense infestations occupying up to 40,000 ha. Formal Weed Action Plans (WAPs) exist for six of the nine stations (Table 5).

Mesquite on Mardie

Australia's single largest Mesquite infestation is located in the West Pilbara on Mardie Station. This infestation is composed largely of the hybrid Mesquite⁸.

The infestation covers some 150,000 ha, including a dense core of 30,000 ha. It arose from two "thornless" Mesquite trees that were planted at the Mardie homestead in the 1930s.

Seeds from those two trees were broadcast deliberately throughout the station in order to provide shade trees for stock, especially when congregating at watering points. The Mesquite naturalised quickly and spread rapidly within the station, notably after floods in 1945 (Anon 2003 – Mesquite Best Practice Manual), giving rise to the current large and, often, dense infestation of thorny trees.

⁸ The Mardie hybrid is described variously as *Prosopis glandulosa* x *velutina* (FloraBase, October 2012); *Prosopis velutina* x *P. glandulosa* var. *glandulosa* x *P. pallida* (van Klinken *et al.* 2006); or [*Prosopis glandulosa* x *P. velutina*] x [*P. juliflora* x *P. pallida*] (L. Anderson, pers. comm. 2012)

Table 7: Mesquite infestations recorded in the Pilbara sub-region

Mesquite in the Pilbara sub-region	IQC database + aerial Survey 2010 + information provided by DAFWA and PMMC (not yet recorded on IQC)
Shire of Port Hedland	One station: at least 1,000 ha One station: 2 plants, recorded as 1 ha
Shire of Roebourne	One station: 150,000 ha One station: 7,000 ha One station: 1 ha Shire Reserve: at least 1,000 ha
Shire of Ashburton	One station: 40,000 ha One station: 35,000 ha One station: 20,000 ha One station: 18,000 ha One station: 3,500 ha One station: unconfirmed Salt production plant: 27,000 ha UCL Onslow Common: 1,000 ha Mt Mini Nature Reserve: unconfirmed
Shire of East Pilbara	No infestations
	Total ~ 303,502 ha

The main infestation on Mardie now includes thousands of hectares of dense Mesquite thickets that cover what was originally prime grazing land on deep alluvial soil near the Fortescue river mouth. Despite concerted control efforts since the early 1950s, the situation has not improved.

Mesquite in the Carnarvon sub-region

Within the Carnarvon sub-region there are four infestations recorded in the DAFWA IQC database from 2000-2012. An aerial survey conducted by PMMC and DAFWA in 2006 identified seven infested areas, which included stations, townsites and watercourses (Table 8).

The Carnarvon Rangelands Biosecurity Association recently reported Mesquite control activities on five properties within the Lake MacLeod catchment and related catchments in the Carnarvon sub-region (Anon 2012). Lake MacLeod is a nationally significant wetland with high conservation and biodiversity values. Mesquite infestations were GPS-logged and mapped, and then treated with herbicides to kill the plants and reduce the risk of seed spread towards the lake. During April and May 2012 a total of 5,613 Mesquite plants were sprayed.

Table 8: Mesquite infestations recorded in the Carnarvon sub-region

Mesquite in the Carnarvon sub-region	IQC database + Gascoyne Mesquite Survey 2006, with areas estimated from points shown on survey maps
Shire of Carnarvon	Carnarvon Common and townsite: 959 ha Along Gascoyne River, West: 1.18 ha Two stations: no data
Shire of Exmouth	One station: 0.8 ha
Shire of Upper Gascoyne	Gascoyne Junction: 15,951 ha Along Gascoyne River, East: 0.08 ha Along Lyons River: 1.29 ha Four stations: no data
Shire of Shark Bay	No infestations
Shire of Murchison	One station: 1,421 ha
	Total ~ 18,334 ha

At present it is not clear whether the entire Carnarvon sub-region has been surveyed for Mesquite and Parkinsonia, or whether unrecorded infestations exist, including on Unallocated Crown Land.

Mesquite in the other Rangelands sub-regions

No Mesquite infestations have been recorded in any of the Shires in the Meekatharra and Kalgoorlie sub-regions, according to the IQC database, relevant DAFWA staff and herbarium records on FloraBase.

2.1.2 Parkinsonia

Parkinsonia in the Kimberley sub-region

Parkinsonia is especially common in the eastern part of the Kimberley sub-region (Table 9) and is more abundant in the Kimberley than in the Pilbara. Only small amounts have been reported in the Carnarvon sub-region.

Based on information presented in the following sections and Tables 5, 9, 10 and 11, the total area infested with Parkinsonia in WA cannot be summarised. This is because the large amounts present in the Kimberley sub-region have not been quantified. In the Pilbara sub-region, Parkinsonia infestations extend along approx. 800 km of rivers and occupy approximately 800 ha of land away from the rivers. Only a few hectares of Parkinsonia have been recorded in the Carnarvon sub-region.

Table 9: Parkinsonia infestations reported in the Kimberley sub-region

Parkinsonia in the Kimberley sub-region	Information provided by DAFWA, 2012
Shire of Wyndham East Kimberley	Entire Ord River catchment Wilson River Bow River Negri River
Shire of Halls Creek	Nicholson River Sturt Creek Ord River Margaret River Mary River
Shire of Derby – West Kimberley	Entire Fitzroy River catchment Margaret River
Shire of Broome	Anna Plains
	Total area not calculated

Parkinsonia in the Pilbara

Surveys conducted by the PMMC and DAFWA in 2010 recorded 21 Parkinsonia infestations in the Pilbara, most of which were on stations and one at the Millstream National Park (Tables 5 & 10). Weed Action Plans (WAPs) exist for about half of the Parkinsonia-affected properties or sites. Parkinsonia co-occurs with Mesquite at eight of the infested properties/sites (Table 5).

The most significant infestation of Parkinsonia in the Pilbara is in the De Grey catchment, where 30,000 ha along the De Grey and Oakover Rivers are infested. Other significant infestations are on the Fortescue River (8,000 ha), Shaw River (6,000 ha) and the Ashburton River (4,200 ha). The remaining infestations are relatively small (<100 ha).

Table 10: Parkinsonia infestations reported in the Pilbara sub-region

Parkinsonia in the Pilbara sub-region	IQC database + 2012 Information provided by DAFWA and PMMC. NB: 'km' = length of river infested
Shire of Port Hedland	One station: 400 ha One station: 140 km One station: 7 km Water reserve: 7 km
Shire of Roebourne	One station: 25 km One station: 20 km One station: 8 km Shire Reserve 4 km
Shire of Ashburton	One station: 85 km One station: 50 km One station: 40 km One station: 28 km One station: 7 km One station: 6 km
Shire of East Pilbara	One station: 400 ha One station: 140 km One station: 130 km One station: 50 km One station: 18 km Millstream National Park (Dept of Water reserve) 20 km
	Total ~ 800 ha + 785 km of river

Parkinsonia in the Carnarvon sub-region

Small localised infestations of scattered Parkinsonia have been discovered recently on a number of Gascoyne pastoral stations. It is not known how these infestations might have arisen.

The Carnarvon Rangelands Biosecurity Association recently reported Parkinsonia eradication activities on a property within the Lake MacLeod catchment in the Carnarvon sub-region (Anon 2012). The infestation consisted of two stands of Parkinsonia, which were treated in April 2012 when a total of 490 plants were treated using basal bark spraying and cut-stump treatments.

It is not known whether other infestations occur beyond the Lake MacLeod catchment.

2.1.3 Prickly acacia

In Western Australia, Prickly acacia is found only in the East Kimberley. There is one large infestation about 40 km south west of Wyndham. It extends over some 15-17,000 ha (see Front Cover) in an area extending from the eastern end of the Durack River north to Nulla Nulla Creek, with small amounts present on two neighbouring stations (Fig. 6). This infestation is believed to have been present for at least 20 years when it was first reported in 2003. The reason for the long delay in reporting this infestation is unknown.

The total area infested with Prickly acacia in WA is approximately 15-17,000 ha, all located within the East Kimberley area of the Kimberley sub-region. None has been reported in the other Rangelands sub-regions.

Since 2002 occasional Prickly acacia plants have been found on the sides of roads leading from the Northern Territory, especially along Buntine Road, with one mature, flowering plant found within the Kununurra Quarantine Stockyards in 2003.

2.2 Prickle bush weed management capacity - strengths and limitations

The following section provides an analysis of strengths and limitations that currently apply to the management of the Prickle bush weeds in WA. The list of topics is not definitive and requires further review and input from the key stakeholders.

Strengths

- Both Mesquite and Parkinsonia have a long history and strong profile as Rangeland weeds and are well known, especially amongst pastoralists. By contrast, Prickly acacia is a relatively new incursion and its the main infestation is relatively inaccessible; consequently, it is not well known by most stakeholders.
- All are Weeds of National Significance (WoNS) and are backed by an extensive current body of information and knowledge on their significance, which includes comprehensive Best Practice Management (or Case Study) guides. Their WoNS status has raised their profile relative to other weeds in the Rangelands.
- The Mardie Mesquite infestation is a powerful reminder of the size and density that infestations can reach.
- Prickly acacia appears to be in the early stages of invasion and establishment in WA, and its current infestations should be eradicable, given this weed's limited number of infestations, and the relatively small area infested.
- Eradication of small, isolated infestations of Mesquite and Parkinsonia will provide strategic benefits.
- In areas affected by these weeds there is a significant number of active pastoralists and other land managers who undertake weed control work, report infestations and participate in bodies such as the Pilbara Regional Biosecurity Group (PRBG), PMMC and OLW.
- The RBG initiative has the potential to bring together a diverse range of views on these weeds. RBGs will also contribute to developing approaches to the management of these weeds that reflect prevailing attitudes within the region.
- Non-DAFWA bodies, especially the Pilbara Mesquite Management Committee and Rangelands NRM, are currently well-resourced and are actively involved with and driving the management of these weeds.

- Local Government is a key stakeholder, especially since some Shire Reserves have infestations of Mesquite and Parkinsonia.
- Mining companies are significant landholders and land managers in the Rangelands, with company-owned transport routes that might pass through areas infested with both weeds, and port facilities and processing plants in near-coastal areas where many of the infestations occur.
- Mining/resource companies can commit significant levels of long-term resources (especially financial) for weed management and will not be dependent on agricultural factors such as cattle prices, mustering durations or seasonal conditions to fund weed management operations.
- Most mining companies have strict environmental management policies that should facilitate management of these weeds, even though the weeds themselves do not have a direct impact on the companies' primary business activity.
- Environmental consultants working for mining companies are, potentially, major partners in undertaking surveillance for both weeds: consultants visit remote places and are likely to a) recognise the weeds and b) record and report them.
- There is further scope for establishing constructive partnerships between key stakeholders for the ongoing management of the Prickle bush weeds.

Limitations

- The declaration categories for Mesquite and Parkinsonia are inappropriate in some parts of their distribution. Prickly acacia is appropriately classified as an eradication target.
- A major limitation to the successful management of these weeds is the large size and remoteness of many of the pastoral properties (and other units of land) on which infestations occur. This can prevent effective control and monitoring being conducted. Also, seasonal weather conditions (the 'Wet') restrict access to many infestations, especially in the Kimberley sub-region.
- Prickly acacia is less widely known to most stakeholders than Mesquite or Parkinsonia.
- Limited resources are available for weed control work in the Rangelands – the Pilbara RBG has only a small budget to provide herbicides and spray operators, and the PMMC and Rangelands NRM have no continuity of funding beyond June 2013 to assist land managers.
- Despite the long history of Mesquite and Parkinsonia as Declared Plants targeted for eradication in the Rangelands, there has been little or no reduction in their abundance. This is probably a reflection of the weeds' vigour and capacity for long distance spread, and to a history of inadequate or inconsistent control.
- The long presence and abundance of Mesquite and Parkinsonia in some parts of the Rangelands might create the impression that these weeds are not significant. The high cost of effective control measures inhibits active management, as does the reduced workforce available to undertake control programs.
- Formal Weed Action Plans (WAPs), backed by Biosecurity Officer, involvement do not exist for all infested properties and localities in the Rangelands.
- Some infested properties that are owned by smaller mining/resource companies that might less emphasis on pastoralism and, therefore, have a limited awareness of the significance and impacts of weeds.
- The massive dominance of the resource industry, especially in the Pilbara, has overshadowed the traditional pastoral industry in the Rangelands and has diminished the profile of biosecurity issues such as weeds associated with pastoralism.

- DAFWA is not consulted routinely during the approvals process for resource exploration or mine site development, and does not receive requests for declared pest information on proposed sites.⁹ This means that:
 - a) Declared plants are not consistently 'on the radar' of resource companies completing exploration or construction projects. This significantly increases the likelihood of weeds spreading across the landscape via seeds trapped on vehicles or heavy machinery
 - b) Extension activities on weeds are often delayed and reactive rather than proactive, reducing the prospect for effective and timely weed management, and
 - c) Opportunities to receive financial assistance or to have funding committed for weed management under Environmental Offset Programs (EOPs) are severely restricted, as EOPs are developed as conditions of approval and signed off prior to any exploration/construction/mining work commencing. Unless there is significant input by DAFWA at the approvals process stage, there is very little chance of getting any additional or significant commitment to manage or control the weeds.

⁹ Resource developers currently ask the Department of Environment and Conservation about environmental weeds associated with mine sites, etc., but DAFWA is not routinely approached about Declared Plants.

3. Surveillance and recording methods

Information on the distribution of these weeds is based on two main sources, namely historical records arising from visits to affected properties by DAFWA Biosecurity Officers, and recent dedicated aerial surveys (the latter mostly arranged by the Pilbara Mesquite Management Committee, PMMC).

Because of the different techniques and operators involved, the data are not stored centrally and are not readily accessible. There is a clear need for consistent data recording and management.

3.1 Mapping and aerial surveys

The PMMC mapped the distribution of Mesquite on Mardie by aerial survey in 2005. Further aerial surveys were conducted by PMMC and DAFWA for Mesquite and Parkinsonia across the Pilbara in 2010. These provided accurate, up-to-date information on the distribution of these two weeds in the Pilbara (Fig. 7).

Aerial surveys were conducted in 2006 and 2008 to provide accurate information on the distribution of Mesquite in the Carnarvon sub-region. It would be appropriate for this aerial survey to be repeated regularly to monitor the extent and distribution of Mesquite in the Carnarvon sub-region and expanded to include Parkinsonia.

Known Mesquite infestations were surveyed aerially in the Kimberley in 2009 and 2012, and the infestation on one station is surveyed annually during aerial application of granular herbicide. Recently, additional areas of Mesquite were found on the same station while undertaking an aerial survey for Rubber Vine (*Cryptostegia grandiflora*).

The detection of Prickly acacia populations and individual trees in the Kimberley has prompted aerial and ground-based surveys to document the distribution of this weed.

3.2 Field reporting

The occurrence, extent and density of the Prickle bush weeds are recorded by Invasive Species Biosecurity Officers during visits to infested properties and other locations. Data are recorded on Field Reporting Forms (FRFs) and entered into the Inspection, Quarantine and Compliance (IQC) database; however, it appears that FRFs have not been lodged for all known infestations of these weeds in recent years.

Data on the distribution and extent of the Prickle bush weeds in WA are scattered, incomplete and hard to access. The IQC database is recognised as being antiquated and in need of replacement or a thorough upgrade. Importantly, the data entered into IQC is not up-to-date for all infestations. [This observation also applies to the reporting of most of declared invasive species. Ways to better address data capture and management are part of the Information and Knowledge Management initiative in DAFWA's "Invasive Species Strategy 2012-2017" (Invasive Species Program 2012)].

3.3 Herbarium specimens

Specimens held by the WA Herbarium provide important, evidence-based information on the WA distribution of these weeds. Maps available via FloraBase (e.g. for Parkinsonia see <http://florabase.dec.wa.gov.au/browse/profile/3673>) are a valuable resource.

The distributions mapped on FloraBase are not comprehensive, since they are based on actual specimens and not sightings; hence, if specimens have not been collected from a particular infestation, it will not be recorded on the FloraBase maps. The maps and specimen records for Mesquite on FloraBase also provide information on which particular species or hybrid is naturalised at each infestation.

4. RISK ASSESSMENT

4.1 Risks

The major risk associated with each of these weeds is its potential to invade much larger areas of the state than are currently occupied.

4.1.1 *Mesquite*

In the Mesquite Best Practice Manual (Anon 2003), risks associated with Mesquite are reflected in comments such as

- “Mesquite is one of Australia’s worst weeds”
- “it infests nearly a million hectares...and...over 70% of the Australian mainland is threatened”
- “Mesquite is so well adapted to arid conditions that populations in Australia can continue to expand even under drought conditions”
- “Mesquite has the potential to become a serious and widespread environmental weed in Australia”
- “if uncontrolled the plant will continue to spread at an increasingly rapid rate”.

4.1.2 *Parkinsonia*

The Parkinsonia National Case Studies Manual (Anon 2004a) states that:

- “Parkinsonia is one of Australia’s worst weeds”
- “It already infests nearly a million hectares and threatens the agricultural and environmental value of over three-quarters of the Australian mainland”
- “Flood-prone country is particularly susceptible to invasion by Parkinsonia”
- “Parkinsonia is now present on almost one million hectares of the Australian mainland... this is only a small fraction of the total area at risk of invasion”
- “There is little doubt that Parkinsonia will continue to spread along watercourses, bore drains and floodplains, as well as adjoining areas throughout the sub-humid, semi-arid and arid environments of north Australia”.

4.1.3 *Prickly acacia*

The Prickly acacia National Case Studies Manual (Anon 2004b) states that:

- “Prickly acacia is one of Australia’s worst weeds”
- “It already infests over 6 million ha of the Mitchell Grass Downs of Queensland” and “has the capacity to invade a further 50 million ha of native grassland”
- Within the core Queensland infestation “the heaviest infestations are along bore drains, watercourses and drainage lines”
- The major areas under threat include most of the northern half of WA; most of northern NSW; nearly all of Queensland apart from parts of Cape York and the high-rainfall east coast; most of the NT apart from the arid southern part of the Territory and most of the ‘Top End’ (Fig. 3 of Anon 2004b).

4.2 Potential for further spread

The current distribution and potential for further spread of Mesquite and Parkinsonia are similar – each weed is reported as occupying close to 1 million hectares (10,000 km²) nationally, but this is only a small fraction of the potential distribution, which amounts to 70-75% of the Australian mainland (Figs 8 and 9; Anon 2003; Anon 2004a).

Prickly acacia already infests over 6 million hectares in Queensland (Fig. 10) which is a much larger area, nationally, than either Mesquite or Parkinsonia, and has considerable potential for further spread in WA, associated primarily with transport corridors for cattle movement and with water movement (Anon 2004b).

Local and long-distance spread of Mesquite and Prickly acacia is closely associated with the movement of cattle and other livestock that have ingested seeds and pods (Mesquite - Anon 2003, van Klinken & Campbell 2009; Prickly acacia – Anon 2004b, Mackey 1998). In order to manage the risk of further spread, some form of holding period will be required to allow stock to excrete any ingested seeds before being moved off-site. This is particularly important for those livestock that have been grazing in areas of dense Mesquite and Prickly acacia infestations, and for stock moving to areas free of these weeds.

4.2.1 *Mesquite potential distribution in WA*

The Mesquite WoNS Strategic Plan (Anon 2000) reports over 250,000 ha of Mesquite infestation in WA, mainly on pastoral land in the Pilbara and Kimberley regions. The calculated infested area has increased since that report was published.

Climate modelling (using CLIMEX) revealed a potential distribution for Mesquite in WA in excess of 25,000,000 ha, mainly in the Pilbara and Kimberley regions, which is a 100-fold increase on the present distribution in this State (Fig. 8: Anon 2000).

The technique of landscape modelling has been used to model habitat suitability for Mesquite in the Pilbara region (Robinson 2008 – cited in van Klinken and White 2009). The model was based on

- Land type, which integrates vegetation type, soil type and topography
- Soil moisture
- Land use (grazing or conservation).

The resulting prediction, shown in Figure 11, closely matched the current distribution of Mesquite on Mardie Station. It also identified substantial non-infested areas that were highly suitable for mesquite, including large portions of the Pilbara coastal plains, especially around river mouths and the Fortescue River floodplains.

The “incipient” Mesquite infestation on the Robe River delta, immediately south-west of Mardie, is also identified as likely to increase in density and extent (van Klinken and White 2009).

A map of the 2006 aerial survey within the Carnarvon sub-region (NB: map not reproduced in this report) clearly shows the distribution of Mesquite along the Gascoyne River system, with infestations spreading along the waterways. The association with waterways is also demonstrated in Figure 7, which shows the 2010 distribution of Mesquite and Parkinsonia in the Pilbara region.

The distribution pathway along waterways is due to seed and pod movement by water and the tendency for stock to move along and preferentially graze waterways.

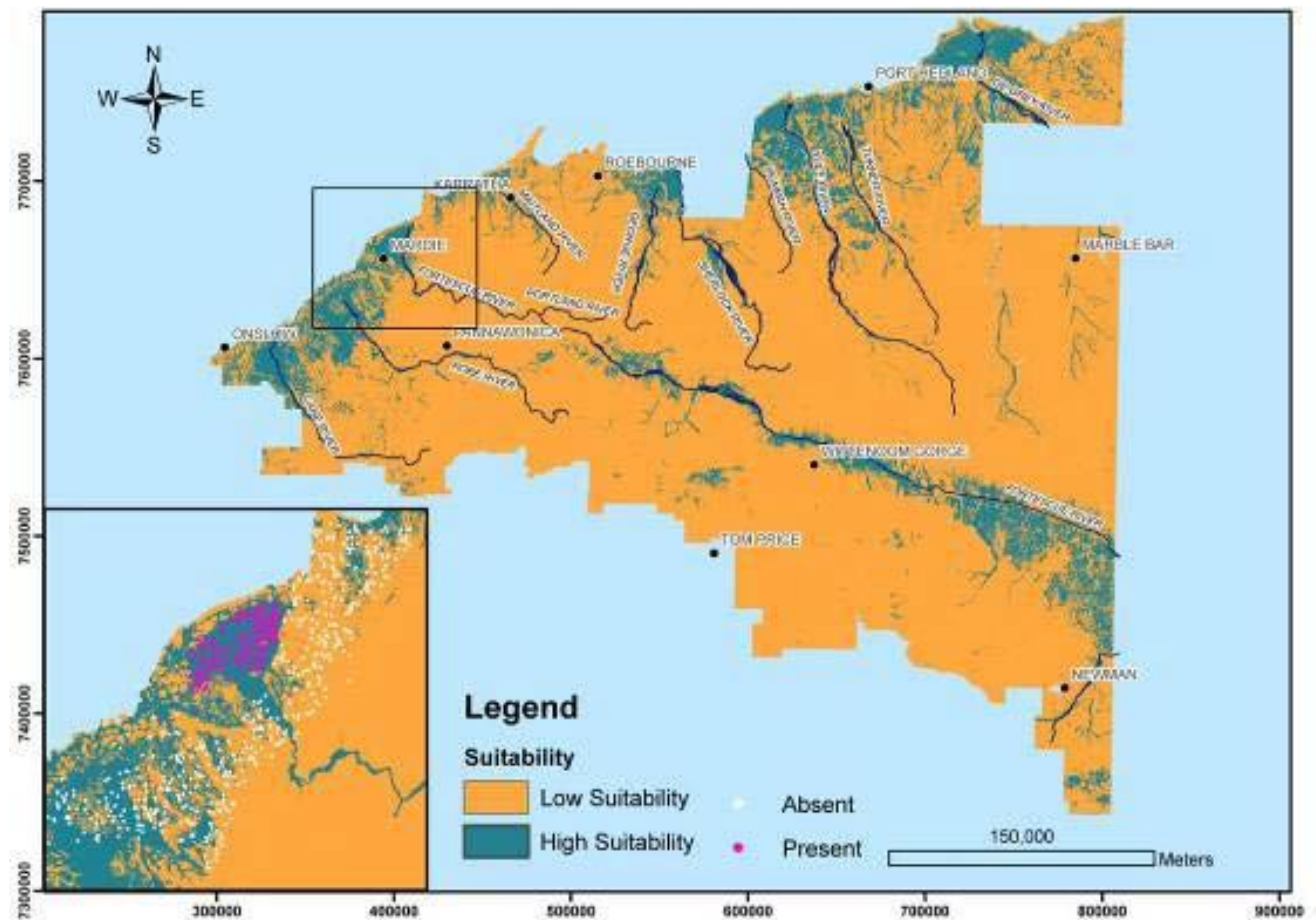


Fig. 11: Map showing the suitability of the Pilbara for Mesquite invasion, split into two suitability classes (Robinson 2008 [PhD thesis]). Note the high suitability along the drainage systems and river mouths along the northern coastline. The insert is Mardie Station overlaid with mesquite presence-absence data (from van Klinken and White 2009).

4.2.2 *Parkinsonia* potential distribution in WA

The current distribution of *Parkinsonia* in WA is described in the *Parkinsonia* WoNS Strategic Plan (Anon 2000) as covering more than 500,000 ha in all river systems in the Pilbara and Kimberley regions, including large infestations along the De Grey, Fitzroy and Ord rivers.

Climate modelling (using CLIMEX) of the potential distribution of *Parkinsonia* in WA (Fig. 9) indicates that favourable climatic conditions exist over most of the State, putting many river systems and adjoining pastoral land at risk. The potential distribution is limited by low temperatures in the southern half of the State.

Given the ecological similarities between *Parkinsonia* and Mesquite, the potential distribution of *Parkinsonia* in the Pilbara sub-region is likely to be very similar to that modelled for Mesquite in the West Pilbara (see Fig. 11).

4.2.3 *Prickly acacia* potential distribution in WA

The potential distribution of *Prickly acacia* in Australia has been predicted using CLIMEX climate modelling and taking into account soil types, transport corridors and water courses (see Fig. 10).

The resulting map indicates that nearly all of the Pilbara and Kimberley sub-regions are suitable for this weed; an exception is the high rainfall Kimberley Plateau in the western part of the Wyndham-East Kimberley Shire. A further prediction of the potential distribution of Prickly acacia is not needed.

4.3 Impacts

The Prickle bush weeds are recognised as serious weeds because of their invasiveness, rate of spread and their economic and environmental impacts.

4.3.1 Mesquite

Economic impacts

The major impact of mesquite is on the pastoral industry. The weed's direct effects are listed in the Mesquite Best Practice Manual (Anon 2003) and include:

- Reduced pasture and loss of production
- Increased financial costs due to lost production, control costs and increased management costs
- Increased difficulty and expense in mustering stock
- Damage to infrastructure when mesquite grows along fence lines and around watering points
- Damage to vehicles by puncturing tyres and scratching paintwork
- Increased medical and veterinary costs for the treatment of injuries cause by mesquite thorns.

Environmental impacts (Anon 2003) include:

- Increased land degradation and loss of soil moisture due to Mesquite's extensive and deep root system
- Increased aquifer draw by tap roots of mesquite – the infestation at Mardie is reported to have lowered the water table by 2 metres
- Loss of biodiversity – Mesquite causes habitat change by competing with and replacing native vegetation
- Provision of refuges for feral animals
- Damage to environmentally sensitive areas, especially water courses.

Social impacts

- These weeds can also impact on culturally significant sites within a landscape, restricting access to or completely destroying them.
- Tourism can also be adversely affected, with very few people wanting to camp and recreate in areas dominated by thorny Mesquite stands.

CSIRO's web pages "Controlling Mesquite in Northern Australia – mesquite weediness elsewhere" (page 9 of 11)¹⁰ provides the following examples of the quantified impacts of Mesquite:

- 75% reduction of the carrying capacity of Mesquite-infested pastures in New Mexico over a 35-year period (Paulsen & Ares 1961)

¹⁰ CSIRO'S WEB PAGES (accessed 20 Dec 2011)

<http://www.csiro.au/Outcomes/Safeguarding-Australia/Mesquite-Control.aspx>

- Annually consistent 50-90% reduction in grass production in arid regions of the USA (DeLoach 1985)
- Direct costs of US\$200-500 million annually in the USA, with losses to total economic activity approximately three times that amount (DeLoach 1985)
- Mean annual surface water runoff reduced by 481 million m³ in South Africa (Impson *et al.* 1999).

4.3.2 Parkinsonia

Parkinsonia affects both the pastoral industry and the environment (Anon 2004).

Economic impacts

- Reduced access to land by people, livestock and native animals due to forming dense, often impenetrable thickets along watercourses, and on floodplains and grasslands
- Restricted access to stock watering points
- Decreased pasture production and stock-carrying capacity
- Major interference with stock mustering
- Provision of refuges for feral animals, especially pigs.

Environmental impacts

- Reduced biodiversity by excluding native vegetation and animals
- Destruction of wildlife habitat
- Contribution to soil erosion
- Choking of watercourses and seasonally wet areas.

Social impacts

- Restricted access to and traditional use of land and water
- Limited access to recreational sites.

4.3.3 Prickly acacia

The impact of Prickly acacia is largely on the pastoral industry (Anon 2004b).

Economic impacts

- Prickly acacia can reduce pasture production and create undesirable changes in pasture composition
- It creates stock hygiene problems and animal welfare issues associated with holding stock long enough to allow Prickly acacia seeds to be voided before the stock are moved to non-infested areas
- It causes mustering and stock-watering difficulties
- Thorns may also damage vehicle tyres.

Environmental impacts

- Loss of wildlife habitat
- Decline in soil structure
- Erosion
- Loss of native pastures
- Decline in biodiversity

- Provision of refuges for feral animals.

Social impacts

- Restricts traditional use of land and water
- Limits access to recreational sites.

Although the qualitative impacts of all the Prickle bush weeds are well documented and the weeds' significance is not disputed, quantitative Benefit Cost Analyses of these weeds have not been conducted, either for WA or nationally. This is possibly due to there being few quantitative data available for these weeds.

ACRONYMS

ARRPA	Agriculture and Related Resources Protection Act, 1976
BAM Act, BAMA	Biosecurity and Agricultural Management Act, 2007
DAFWA	Department of Agriculture and Food, Western Australia
EOP	Environmental Offset Program
FRF	Field Reporting Form
OLW	Ord Land and Water
PMP	Property Management Plan
RBG	Recognised Biosecurity Group
UCL	Unallocated Crown Land
WAP	Weed Action Plan
WoNS	Weed (or Weeds) of National Significance
ZCA	Zone Control Authority (a regional group, now replaced by RBGs)

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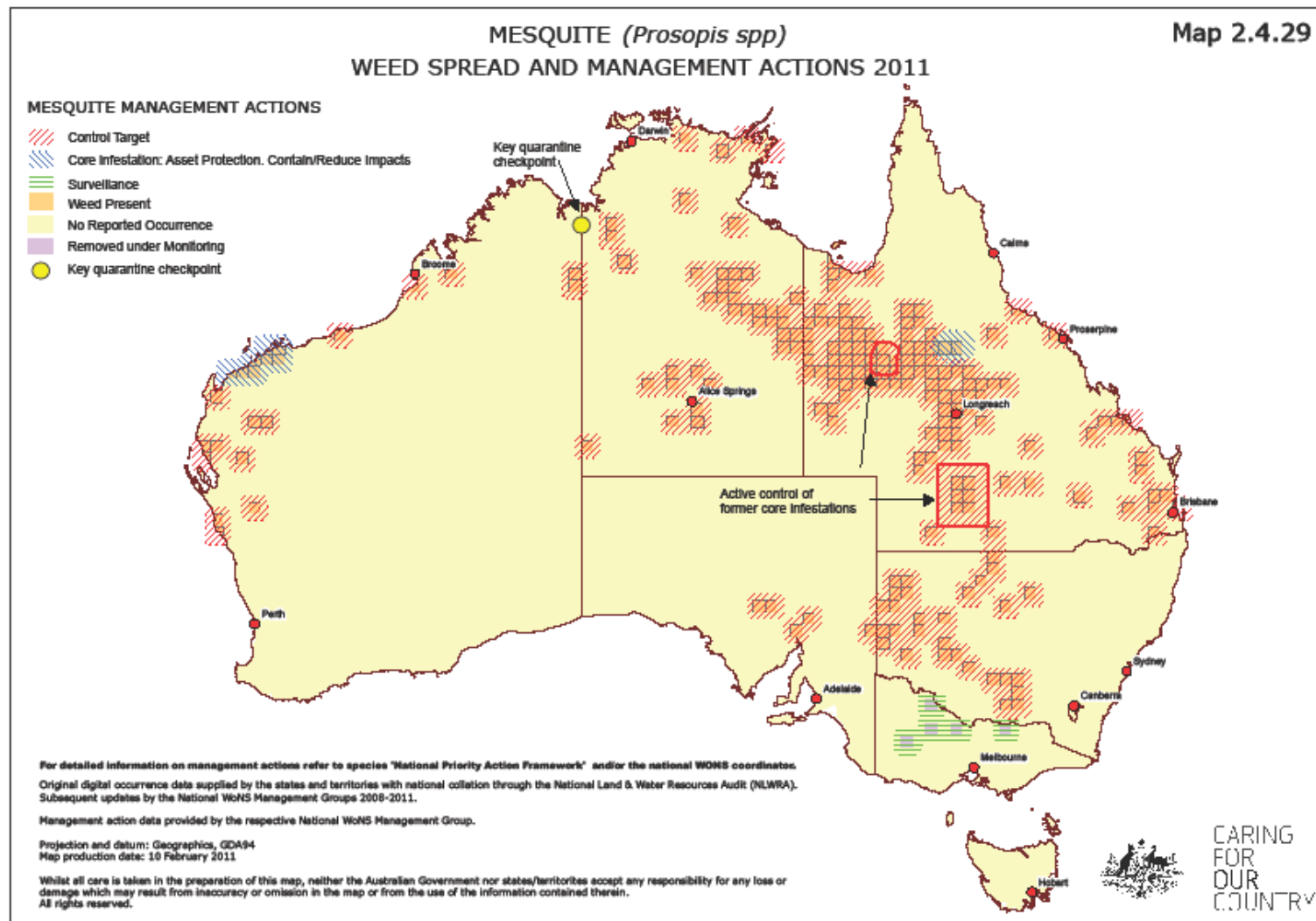


Fig. 2: Mesquite (WoNS) Management Action Map (from Anon 2010)

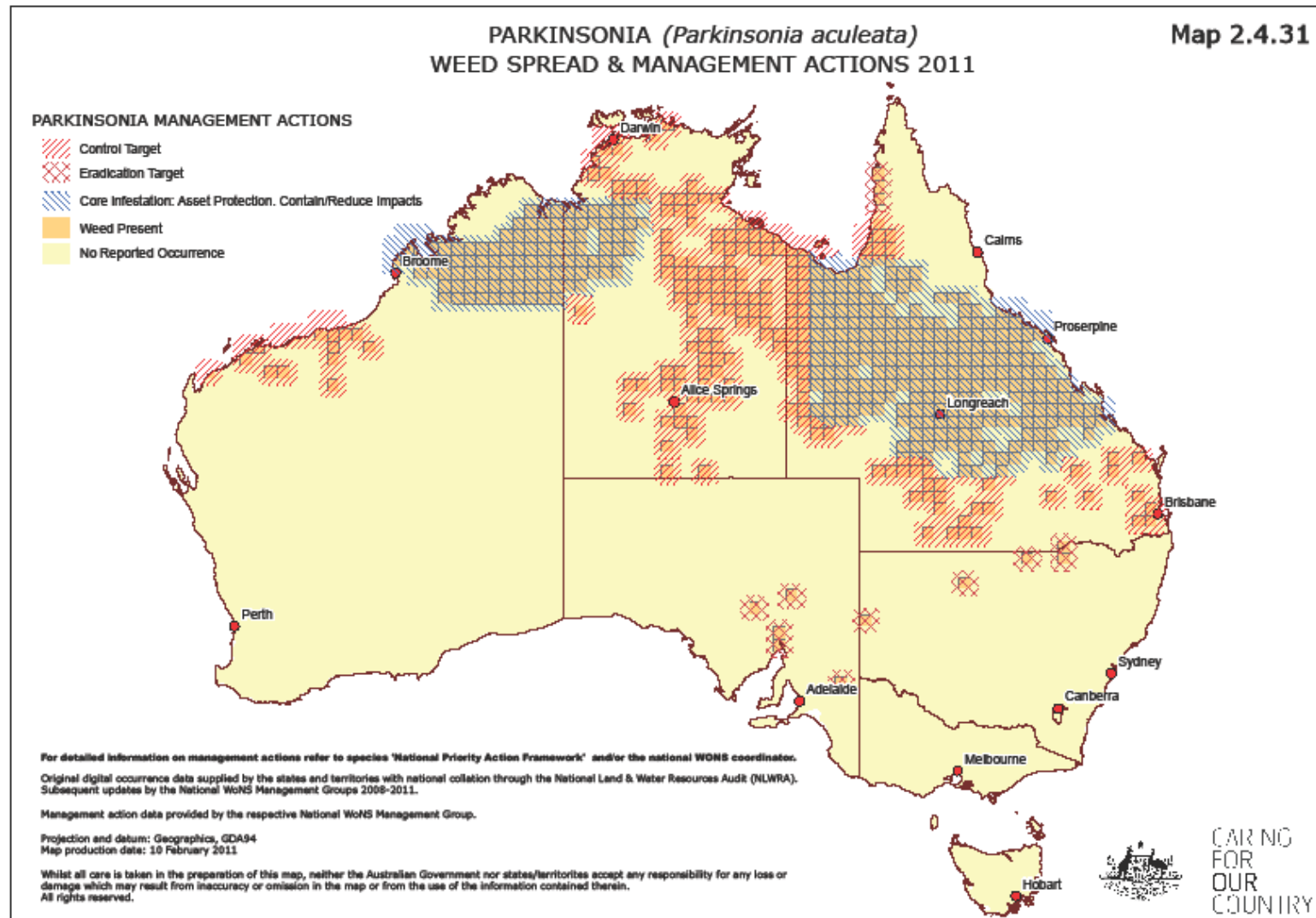


Fig. 3: Parkinsonia (WoNS) Management Action Map (from Anon 2010)

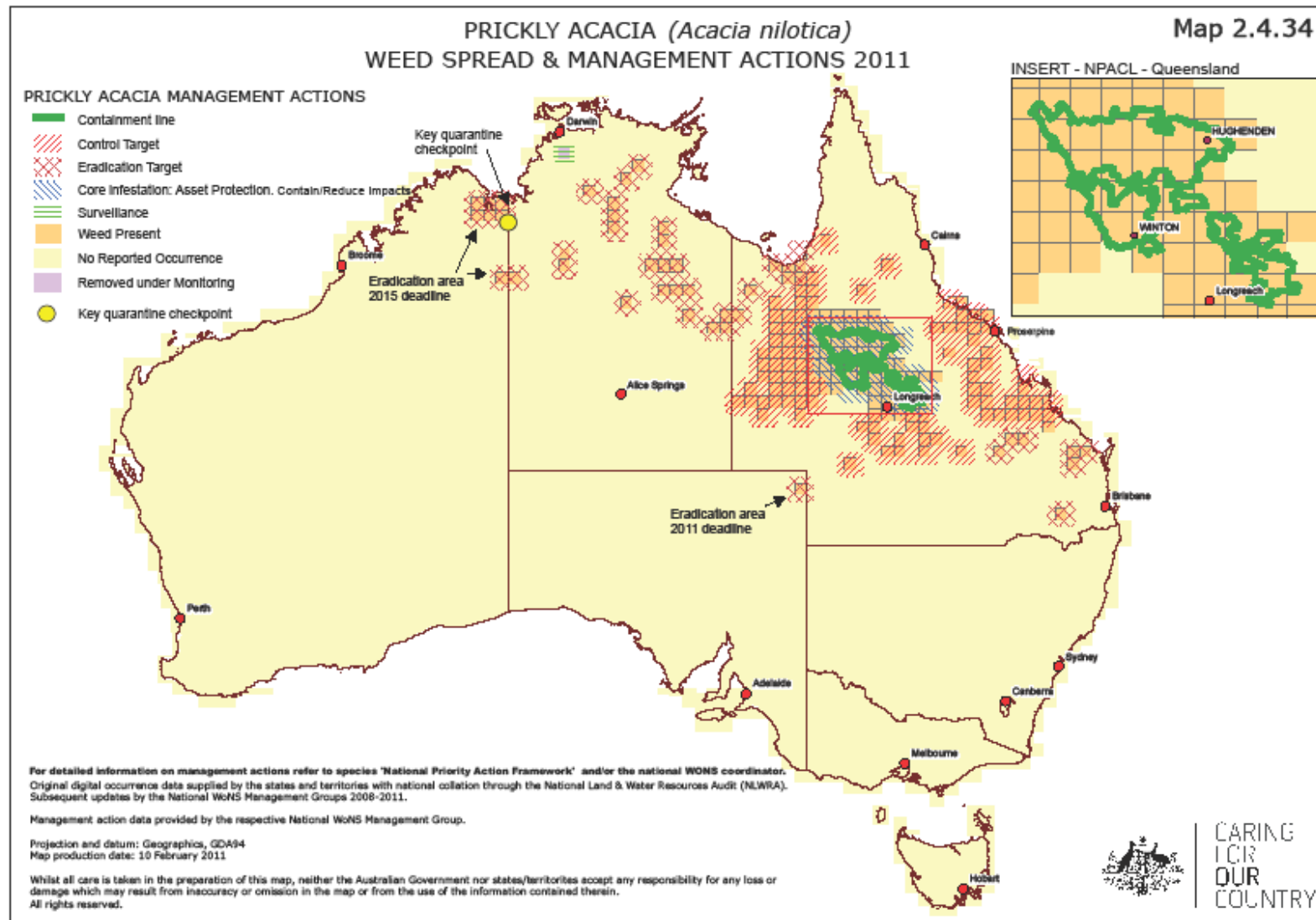


Fig. 4: Prickly acacia (WoNS) Management Action Map (from Anon 2010)

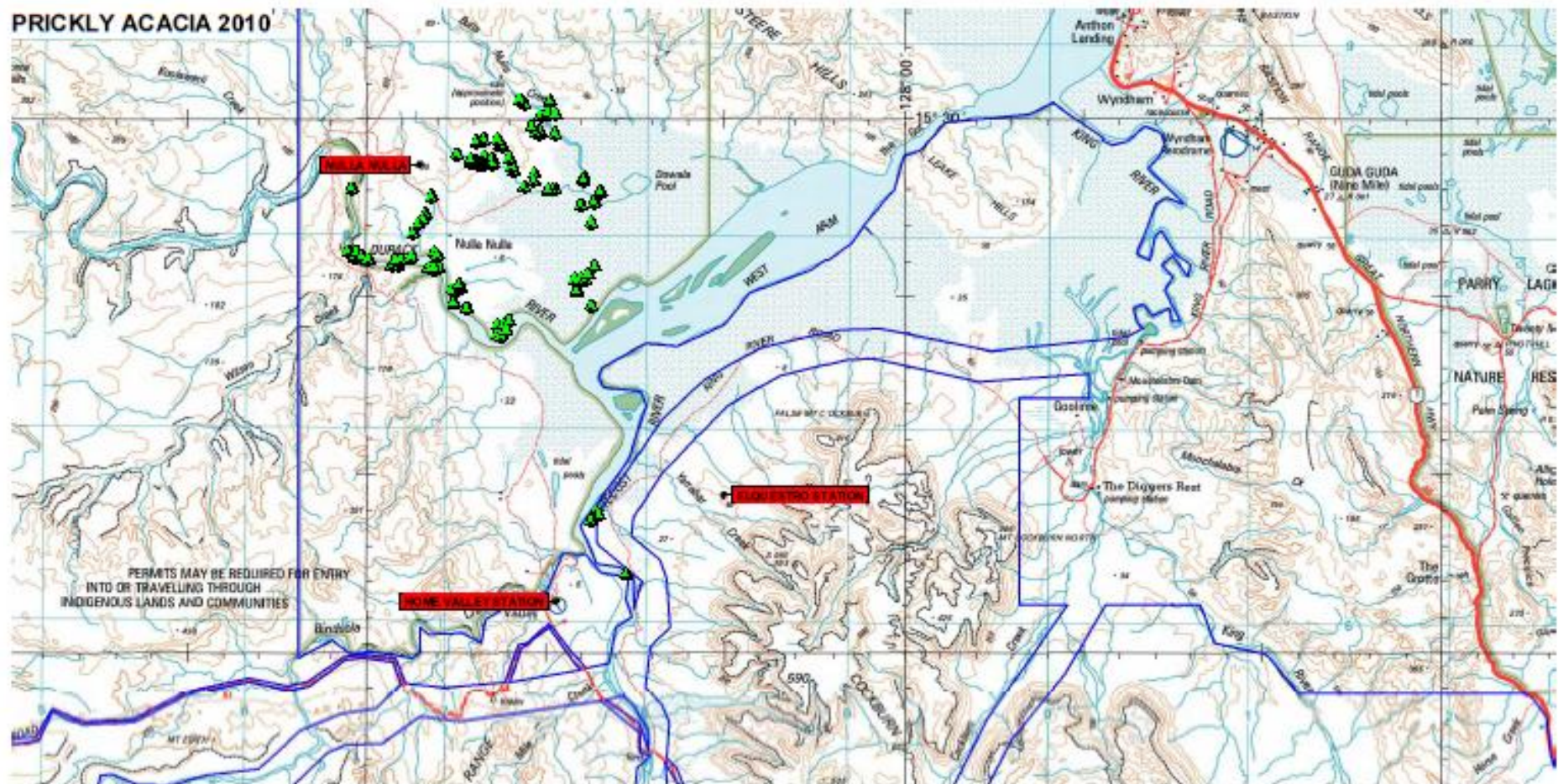


Fig. 6: Distribution of Prickly acacia ('Tree' symbols) west of Wyndham, East Kimberley, 2010

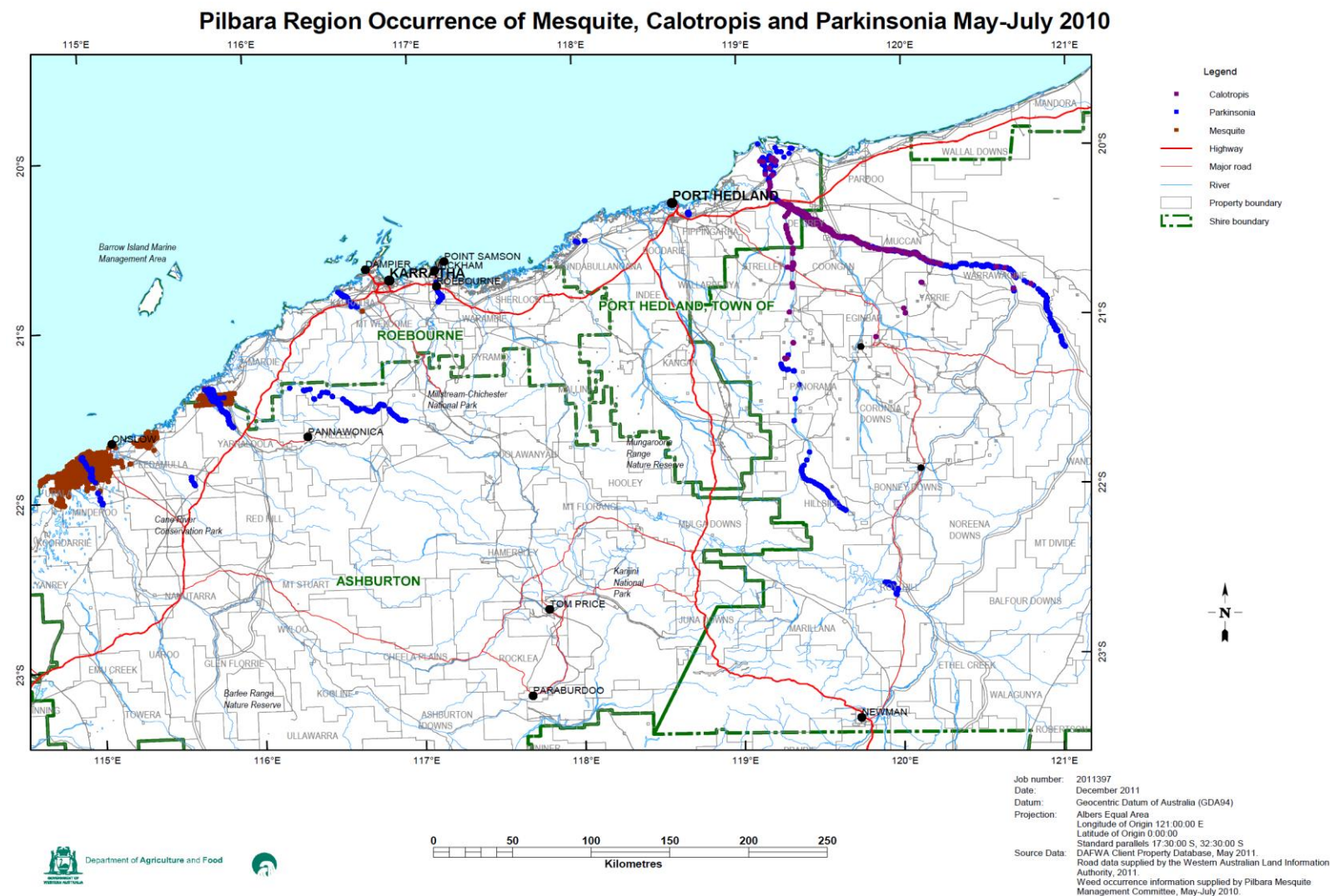
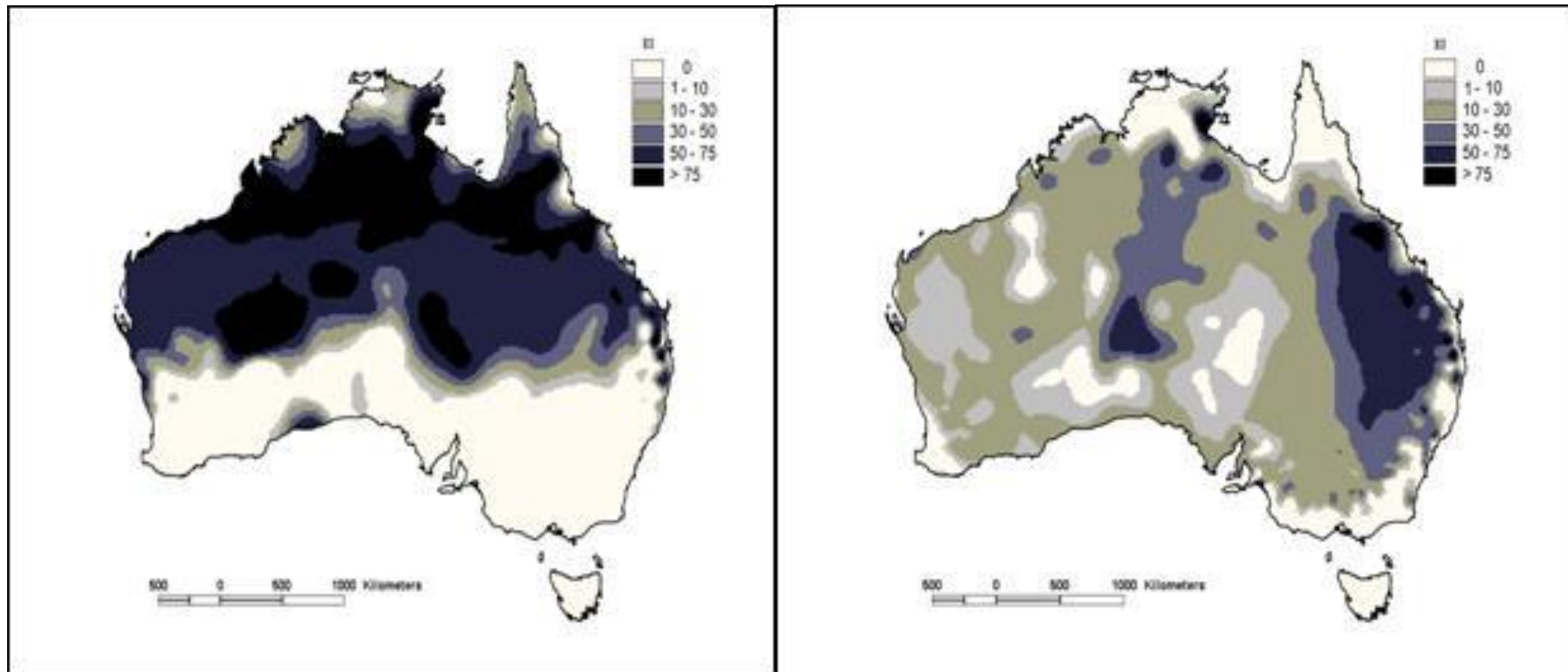


Fig. 7: Occurrence of Mesquite (red) and Parkinsonia (blue) in the Pilbara, May-July 2010.
NB: infestations on Mardie Station were mapped in 2006 and are not shown on this map.



(a) *Prosopis glandulosa* and *P. velutina*

(b) *Prosopis pallida*

Fig. 8: Potential distribution of three mesquite species in Australia. Maps provided by CSIRO. Data is splined from a CLIMEX climate prediction. EI = ecoclimatic index: EI<30 = potential for permanent population is low, EI>50 = potential for permanent population is very high.

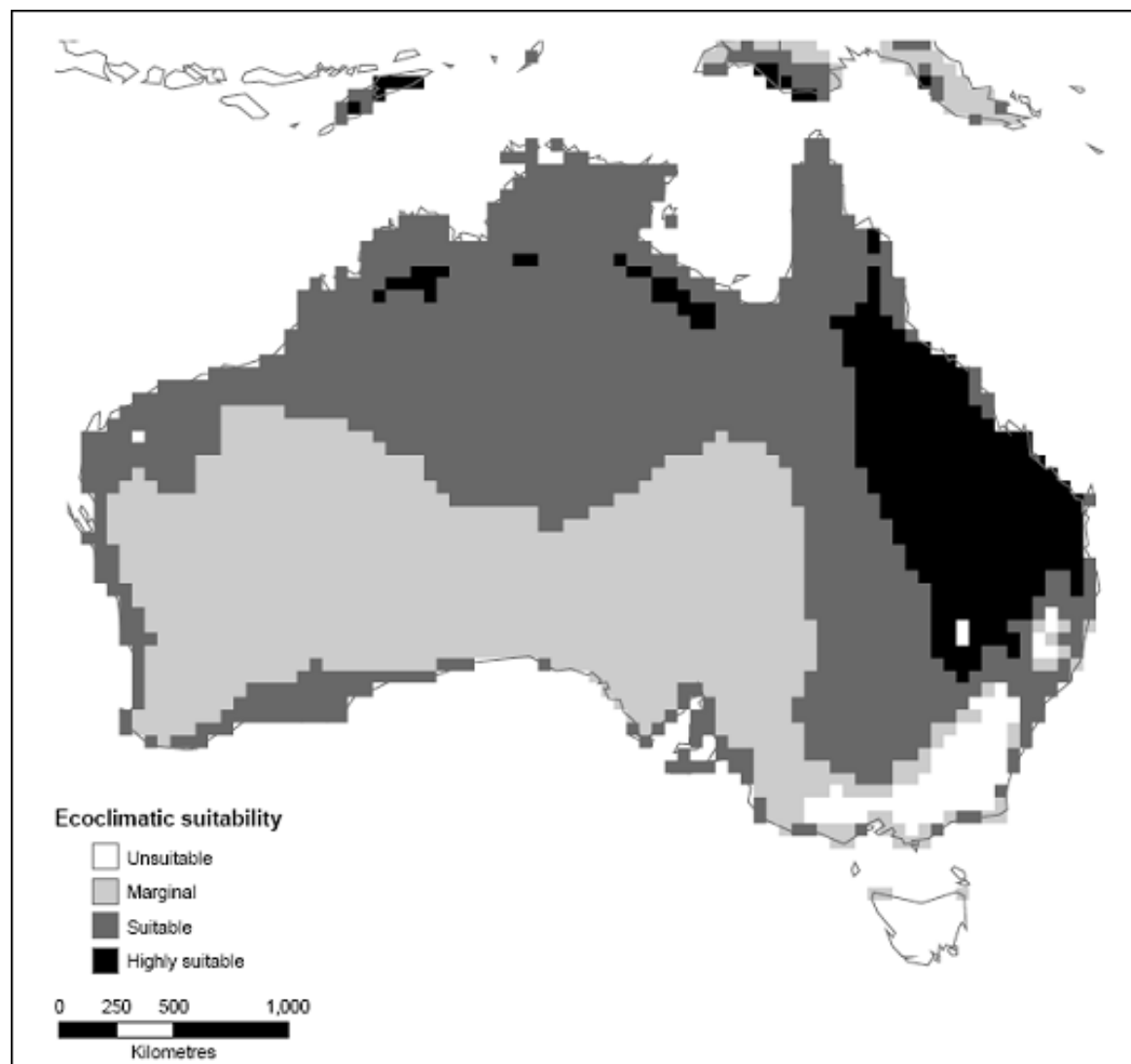


Fig. 9: Potential distribution of Parkinsonia in Australia (2011).
Source: CSIRO. Data is splined from a CLIMEX climate prediction.

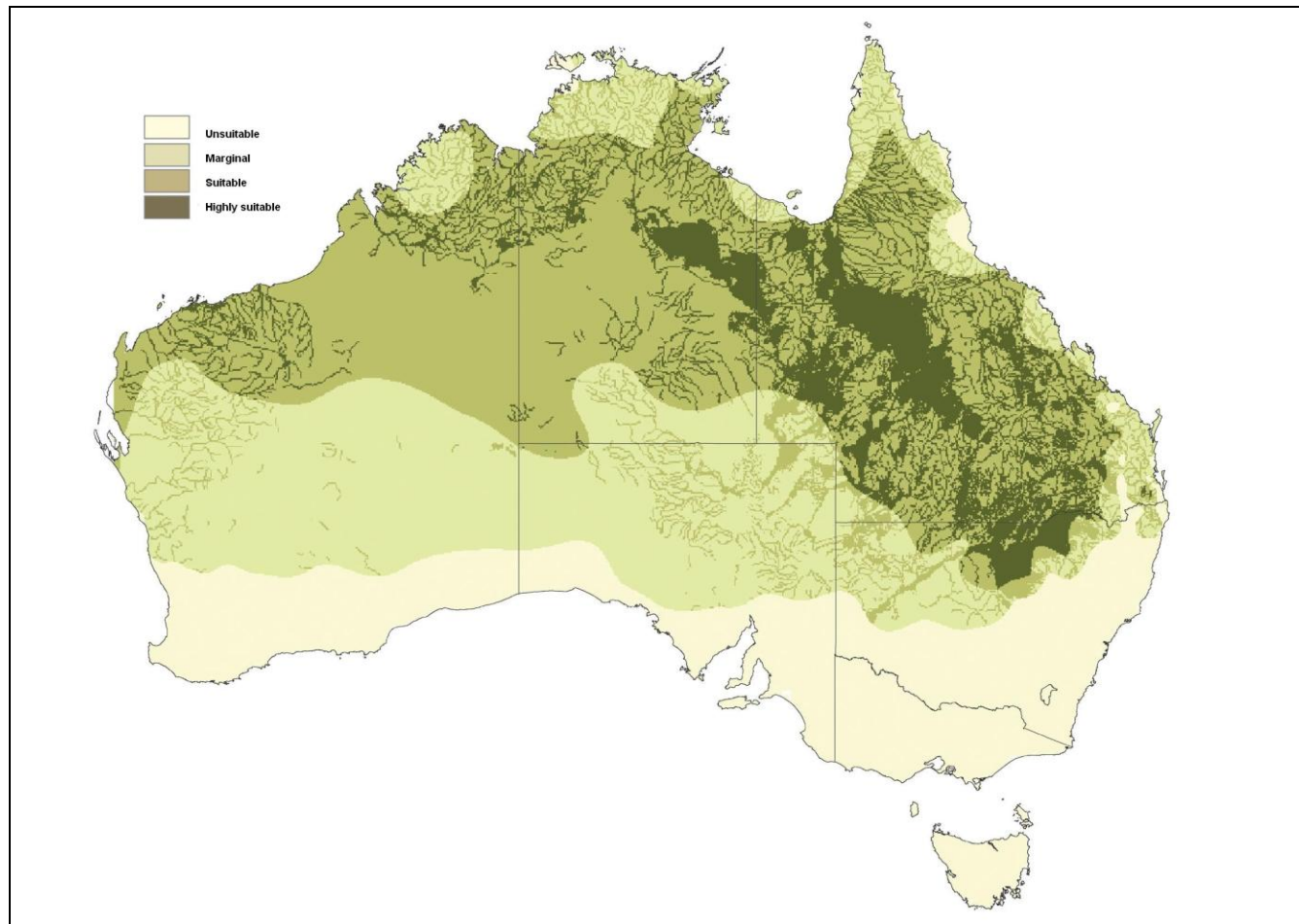


Fig. 10: Potential distribution of Prickly acacia (from Anon 2004b)

